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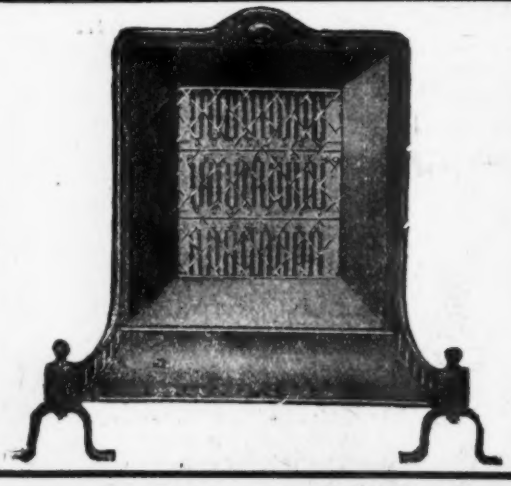

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THE PRICE OF THE "ELECTRICAL REVIEW."

During the War, almost exceptionally among technical publications and periodicals of the character of the ELECTRICAL REVIEW, we have refrained from increasing the price. Owing, however, to the constant increases in cost of paper, printing, engraving and production charges generally, we have reluctantly decided that the price from the beginning of this year must be raised to 6d. per copy. The change will not apply to unexpired subscriptions.

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THE LESSON OF THE MOULDERS' STRIKE.

THE morning papers of January 23rd contained the welcome announcement that by a majority of over 6,000 the moulders had voted in favour of a return to work, the strike having lasted since September 20th, 1919.

All men have a perfect right to refuse to work, or to withdraw their labour, if they consider the conditions of employment unsatisfactory in any particular. We use the plural number because it is lawful to combine together to do this—in short, to strike is lawful.

In all the long history of labour disputes, however, it is improbable that there has ever been a strike more deplorable than the one just ended. Certainly this is true so far as engineering is concerned. The moulders broke away from their Federation, and decided to fight for themselves. The remainder saw that the situation was hopeless from the start, and so stayed at work. They started out on this hopeless business, putting forward demands which failed to produce the desired effect, either on the employers or upon public opinion. With a stubbornness which, in a better cause, would have been worthy of admiration, they fought on, twice rejecting a settlement, until the strike had lasted for 17 weeks. At the end of all this privation for themselves, their wives and families, they have gained nothing but the promise of an inquiry, which, we make bold to aver, would have been assented to and participated in gladly by the employers at the very commencement. The five shillings advance would have been paid to the moulders in common with other engineering workers; and machinery for the avoidance of disputes could, with the men's goodwill, be set up to-morrow, in accordance with many famous examples already in existence — the Building Trades Parliament, recently discussed in these columns, for one.

The cost to the men and their dependents has been great, but it has not stopped there. Many other workers have been unable to earn their livelihood, and it is well known that some of the largest firms were within an ace of having to close down completely, not only their works, but their offices; of having to stop not only their operatives, but their administrative staffs. The cost to the country has been enormous, and even now it will be several months before work can proceed normally. And all this at a time when the one thing needful is to produce the goods of which the poor old world has been deprived for over five years.

There is, as we admitted at the outset, a right to strike. But all rights have their accompanying duties, and in this case the duty is to see that the misery of the resultant warfare falls on the enemy. The whole duty of any individual is so to live his day that the community may be better at the end of the day than it would have been but for his day's effort. If the conditions of employment in respect of reward, circumstances, atmosphere, are such that it would be a shame to perpetuate them, then it is the workers' duty to refuse to submit to them, and so advance the common welfare by sweeping intolerable conditions away. But when this is not the case, then one's duty is to get on with the job. All strikes that have succeeded have been strikes against injustice. Public opinion is, and must remain, the final judge. The public, particularly the British public, has a fine sense of fair play. This sense was roused, to take a famous example, by the Dock Strike in the 'eighties of last century, but it is most emphatically not impressed in the slightest by the moulders' claim for 15s.

a week increase, with no prospect of finality, and bound to spread in all directions as the Churchillian 12½ per cent. still continues to do.

This strike could, as we have said, have ended on two earlier occasions, if the men had accepted the recommendations and advice of those whom they appoint and pay to act for them. With all allowance for the unworthy prominence of the mere agitator—the gas-bag, in fact—in labour, as in other walks of life, it ought to be possible to assume that these chosen leaders are capable men, who, being in close touch with the other side, will be in a position to offer sound advice. The men have, of course, the right to refuse to follow it, and the moulders have twice exercised that right—with the results we now see! It may be that the very failure of this strike will have a tendency to restore the authority of Trade Union leaders among their rank and file. Surely, if a man is selected as a leader, it is the duty of the rank and file to follow him, or else to appoint someone else. The rank and file have the supreme authority, but that authority is not properly displayed by the continual flouting of direction and refusal to follow advice.

The weapon of the strike is effective, but terrible. Negotiations take time, and inevitably engender impatience. Then comes the temptation to use the weapon unjustifiably, and great strength is better shown by the avoidance of the use of the weapon than by its employment on every occasion, or even the threat of its employment. The drum is an effective instrument, and acceptable in its place in the orchestra, but if the drummer beats it in somebody's bedroom, he will not be praised for a clever drummer, but cursed as an intolerable nuisance.

It seems almost incredible that, in an age so predominantly commercial as the present, we should have failed to get away from brute force for the settlement of industrial and international disputes. In personal affairs it has long since been dropped, and we can all, however aggrieved, repair to an impartial tribunal for the settlement, on just lines, of any conflict. We have not reached the stage of compulsory arbitration yet, but we have industrial courts, and it is probable that already a serious strike at the docks has been avoided by recourse to them. May all parties make free use of them, and may they justify their existence!

Not by the winning or the losing, but by the avoidance, of industrial disputes, shall we be able to get ahead with the work, and to do the right thing by the country and ourselves.

The Commercial Engineer.

AT the inaugural meeting of the new Liverpool Sub-Centre of the Institution of Electrical Engineers, Dr. Marchant, *inter alia*, drew attention to the importance of sound commercial training to the engineer. As he pointed out, the economic efficiency of an undertaking is even more important than its technical efficiency; no matter how admirable a project may be from the latter point of view, it is worthless unless it is a paying proposition, and the engineer who is competent only on the technical side, is not fully equipped to deal with the problems that will confront him in the future.

There is another aspect of the question, to which also Dr. Marchant referred—the fact that the commercial representative who is not *au fait* with the technical side of his subject is equally deficient in training for his vocation, especially when he is called upon to act in foreign countries on behalf of British firms. To meet the competition with which we shall be faced abroad, it is essential that our "trade ambassadors" shall be provided with every weapon that is available, including especially commercial, technical, and linguistic attainments of a high order, and we cordially agree that the admirable movement on the part of our modern Universities towards the establishment of schools of commerce should be fostered, with a view to the equipment of the engineer with the "munitions of war" appropriate to peace conditions. We have often pressed these points upon the attention of our readers, and we welcome the support of so notable an exponent of the fundamental principles of engineering training.

The Trade Contest With Germany.

A SERIES of articles by M. Paul Genty is being published by a Paris newspaper, dealing with the economic contest between the Allies and Germany. The articles are mostly a record of the progress made during the war in England, France, the United States, and Japan. In the case of the electrical industry, the author states that as compared with France, Germany in pre-war times had a considerable excess of exports of electrical manufactures. Nevertheless, French electrical firms in general were able to meet the demands for electrical equipment during the war, so that no difficulties arose from the cessation of imports from Germany. Switzerland and the United States supplied the products which were lacking, whilst the necessities of the war acted as a stimulus to French industry. A syndicate was formed to combat German competition in the world, concessions in tariffs were demanded, and an increased utilisation of water power was undertaken. Turning to the consideration of the position of the United States, M. Genty states that the electrical exports of that country were doubled during the war. However, the difficulties incidental to ship tonnage, "an insufficient knowledge of the market," the special qualities required for deliveries under war contracts, and the scarcity of labour hampered the development of the electrical industry in the United States. The industry in Japan also made considerable progress, makers passing from machines of ordinary size to those of large powers, which were sold at moderate prices. The availability of raw materials at low prices, such as copper and silk, and of hydro-electric power, facilitated the development of the industry, and the country was soon able to compete successfully with others, especially as current manufactures could be produced very cheaply. It is said that the Government by the grant of export bounties encouraged exports to China and India, and the makers proceeded to increase their productive capacity in the German fashion, so as to be able to carry out large contracts. The author concludes that German competition will be completely ousted by England, France, the United States, and Japan, unless Germany succeeds in outstripping these countries by a solution of labour questions, which are the principal causes that can impede the restoration of the economic life of the country.

A Double-Edged Sword.

As a result of the apprehensions which have arisen in Germany in recent months as to the possibility of foreigners buying ordinary shares in industrial companies, and securing a majority control over the undertakings, a system has been introduced of creating preference shares which are given up to 20 times the voting powers of the ordinary shares. In other words, a preference share may carry up to 20 votes, as compared with one vote for each ordinary share. It is hoped in this way to counteract any foreign intervention in German industry. The initiative in this direction was taken by the aniline dye combination two or three months ago, and was soon followed by certain shipping companies, whilst many industrial companies have also adopted the same policy. It has occurred to some people, however, that besides averting foreign control, preference shares with many votes can also be utilised for depriving German holders of ordinary shares of their rights by out-voting them in general meeting. Not only so, but the banks are coming to the conclusion that the issue of such preference shares is only justified when foreign influence is directly impending. A solution of the problem is now being sought by the Lloyd Dynamo Works Co., of Bremen, which is seeking the sanction of the shareholders to the creation of preference shares for 200,000 marks, each having 20 votes, so that they would equal in voting power the ordinary share capital, which is being increased to 4,000,000 marks. The preference shares, however, will only be issued if necessary, and the right of emission will lapse with the end of 1925. Should the occasion arise, it will be possible for the directors to issue the preference share capital, and thus check foreign control, especially as all ordinary shares are never represented at any company meeting.

I.E.E. Progress.

WE have previously referred to the rapid increase in the membership of the Institution of Electrical Engineers; at the meeting last week 234 new members were elected, including 34 Associate Members, 27 Graduates, and 168 Students. That so large a proportion was in the junior class by no means discounts the value of the list—a constant inflow of young blood is essential to the maintenance of the health and vigour of the organisation. What especially interests us on this occasion is the fact that the membership, which at October 1st, 1919, was 7,792, is now well over 8,000—a splendid record.

No doubt many factors contribute to this noteworthy development; but one, we believe, overshadows all the rest—namely, the steady increase in the efficiency and usefulness and the broadening of the interests of the Institution, which, under the effective guidance and driving force of Mr. C. H. Wordingham during his energetic two years in the chair, has become so much more real and human to its members and its critics.

Petrol and Electricity.

CONSIDERABLE agitation is prevalent in the automobile world in view of the threatened increase in the price of petrol, and the probability that the petrol tax will be removed by the Government. On the surface, it would seem that these two factors, being of opposite sense, would tend to neutralise one another, but as a matter of fact the tax will only be transferred from petrol to some other basis, and automobilists do not anticipate any relief in that respect. We are here mainly concerned with the increasing cost of petrol, which will not promote a reduction in the price of benzol or other substitutes, though it will stimulate the movement towards the adoption of alcohol.

Now, the cost of energy for propelling a railless trolley-car is about 1¼d. per mile; that of petrol for a motor-'bus is already over 5d., and is going up; when all running expenses are taken into account, the cost of railless traction is about 11d. per car-mile, against 17d. per 'bus-mile, leaving a margin far more than sufficient to pay the capital charges in respect of the overhead construction, even if we assume that the cost of upkeep of the roads, and the life of the vehicles, are the same in both cases—an assumption which errs greatly in favour of the omnibus.

Again, the cost of running a storage battery omnibus is about 10d. per mile. In by-gone days the battery-'bus earned a very unsavoury reputation, but the undoubted success of battery vehicles during the past 10 years has redeemed their character, and there is no doubt that a modern battery-'bus is a commercially sound proposition. The superiority of the electric battery vehicle for municipal sanitary purposes is now so well established that it requires no emphasis.

Thus, it will be seen that the prospects for electric traction on roads are highly favourable, and there is good reason to anticipate rapid developments in this direction. The only obstacle to the more extended use of the private battery car is the lack of charging facilities; this deficiency is being slowly remedied, and it rests with electricity supply authorities to accelerate the provision of charging stations, and to make their existence widely known. We commend the matter to the notice of the Ministry of Transport as one deserving immediate attention.

Electricity Supply.

Now that the Bill, in its abbreviated form, has become an Act, it is worth while to consider its immediate bearing upon the electricity supply industry. In our last issue we gave a summary of the Act, which, in spite of its curtailment, remains a measure of the first importance, and contains many provisions of very great value to the industry. As announced in our pages, the Ministry of Transport took over its new duties on Friday last; it is greatly to be regretted that the Commissioners, with the exception of the Chief Commissioner, Sir John Snell, have not yet been appointed, as there is plenty of work awaiting their attention, and at least two are necessary to form a quorum. Besides, is not the supply world looking forward with keen interest to the disclosure of the *personnel* of its new general staff?

The Commissioners, when they come into existence, will at once become the authority charged with the administration of the Electric Lighting Acts, including the sanctioning of borrowing by municipal authorities; "special orders" made by them and confirmed by the Minister of Transport will take the place of provisional orders, and the mass of routine work which will fall upon their shoulders will give them ample occupation. But one of their first duties will be to organise the country into "separate electricity districts," and to set on foot the preparation of schemes for improving the "existing organisation"—mainly conspicuous by its absence—and, *if necessary*, forming joint electricity authorities. This work has been informally commenced by the Board of Trade as regards certain areas, as will have been gathered from references in our columns during the past two years, and the authorities and companies concerned will do wisely and well if they follow the example of certain provincial areas and get to work on the formulation of co-operative schemes. In their default, the Commissioners have power to formulate and put into force schemes of their own, lacking only the power of compulsory purchase.

A joint electricity authority, when formed, must comply with the general directions of the Commissioners, submit all proposals for capital expenditure (beyond a prescribed limit) for their approval, render accounts of income and expenditure annually, and furnish a report of the year's work. Pending the formation of a joint electricity authority, existing authorised undertakers not only may, but if required by the Commissioners, must, make arrangements for mutual assistance, on terms to be approved, or if necessary imposed, by the Commissioners; and they may be called upon to change their system of supply, subject to the right of appeal to the Minister of Transport.

Private undertakings have now come under the control of the Ministry; no new station or main transmission line whatever may be erected without the consent of the Commissioners, unless they comply with regulations which have not yet been formulated.

On the other hand, if the liberty of the individual is to some extent restricted, valuable compensation is found in the improved facilities for obtaining compulsory wayleaves, erecting overhead mains without the consent of local authorities, using land for generating stations, obtaining cooling water, &c.

It is clear, from the foregoing, that the Act affords abundant scope for the Commissioners, with the collaboration of the authorised undertakers, to accomplish a great deal of valuable work. Whether the clauses that were jettisoned will ever be enacted, remains a moot question; certainly there is no urgent need for them.

A correspondent to-day remonstrates with us on the score of undue severity towards a writer in *The Times Trade Supplement*, who said that under the Act the undertakers retain their autonomy, but under the Bill as it left the House of Commons, their autonomy would at once have been cut short. As we have shown above, their present "autonomy" is by no means unrestricted; but under the complete Bill they would have had precisely the same opportunities to come together and form joint electricity authorities, selling their stations, if desired, by agreement. It is the will of the nation, as expressed by the House of Commons, that electrical undertakings shall join hands with a view to improving the supply of electricity. The original Bill provided compulsory powers to that end; but those powers could not be exercised without holding a local inquiry, and they could not be put in force without approval by resolution of each House of Parliament. To provide the power to do a thing in case of necessity is a vastly different thing from doing it; the police have power to arrest any British citizen, under certain circumstances, but, nevertheless, the British citizen is a free man—perhaps the freest in the world. In the same way, supply authorities, if they complied with the law (as yet unwritten) requiring co-operation, would have nothing to fear from the big stick which was put on the shelf by the House of Lords; and they would not lose the measure of autonomy which they now enjoy.

THE ELECTRICAL EQUIPMENT OF PALMERS SHIPBUILDING AND IRON CO.'S WORKS.

(*Concluded from page* 101.)

Electrical driving has been adopted generally throughout the whole of the works and steam plant is being almost entirely done away with. At the shipyard the whole of the driving is now done electrically, the largest motors being employed to drive 700-H.P. air compressors for the general supply of compressed air used in the various branches of ship construction.

At the iron and steel works the whole of the overhead cranes, charging machines, main water supply, and hydraulic pumps, are electrically driven, and in addition the rolling mills are being fitted with motors to replace large steam engines, the auxiliary plant necessary for driving live rollers and skids having already been converted for electric driving.

The rolling mill installation has been carried out by the Metropolitan-Vickers Electrical Co. (late British Westinghouse Electric and Manufacturing Co.).

The mill motor (fig. 5) has been designed for, and is dealing with, a torque of 140 foot-tons at a speed of 40 R.P.M., which figure is well above that met with in rolling the particular size and weight of ingot over the time specified; for instance, rolling 4-ton ingots, 20 in. by 18 in. to 6 in. by 6·5 in., an output of over 35 tons per hour is easily obtained.

The stopping and accelerating of the mill motor extremely rapidly is absolutely essential if the maximum output is to be reached. In this connection it should be remembered that with Ward-Leonard control the generator field at the end of every pass is reduced to zero value during the reversal of the mill, and is then built up in the required direction, until the selected speed on the mill motor is obtained. Although the torque due to the inertia of the masses to be stopped or started in the time by the mill motor is small compared with the torque due to the resistance of rolling and friction, the former must be impressed within an extremely short interval of time. Further, in order to effect the rapid stopping of the mill motor against its own inertia and the inertia of the other moving masses, the generator field is first reduced, and the motor then acts as a generator, returning energy to the line by way of the generator and induction motor. The machine is then brought quickly to rest, and may be reversed in an exceedingly short space of time. Either an electric or a steam plant can be brought to rest in a short space of time, the advantage, if anything, being with the electric plant, as almost any magnitude of momentary negative torque is available for the purpose of decelerating. This being so, it remains to be seen in what manner the electrical equipment is speeded up. It might be thought that, at first glance, the steam engine would have the advantage, and could accelerate the mill, &c., by the operator quickly moving the throttle to full open, thus impressing full available pressure on the pistons. The arrangement of the electric controls and gear by which equivalent results are obtained is illustrated diagrammatically in fig. 6, in which, for the sake of clearness, all switchgear and instruments have been omitted.

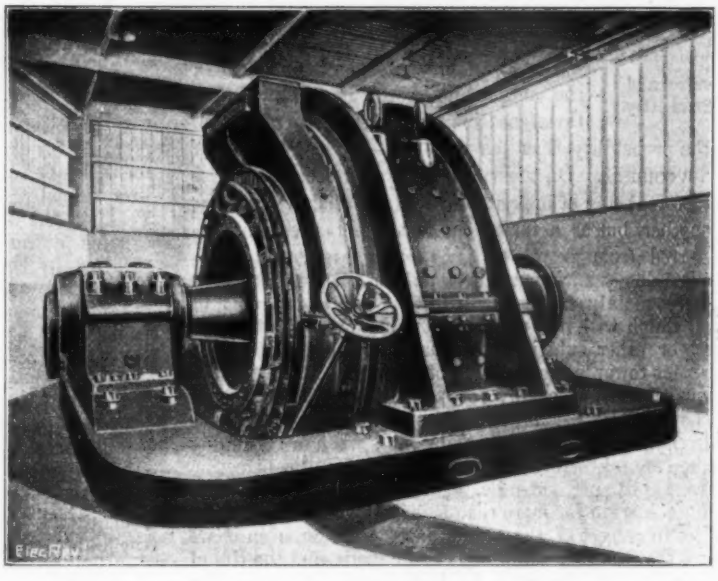

FIG. 5.—AN 8,500-H.P. ROLLING-MILL MOTOR.

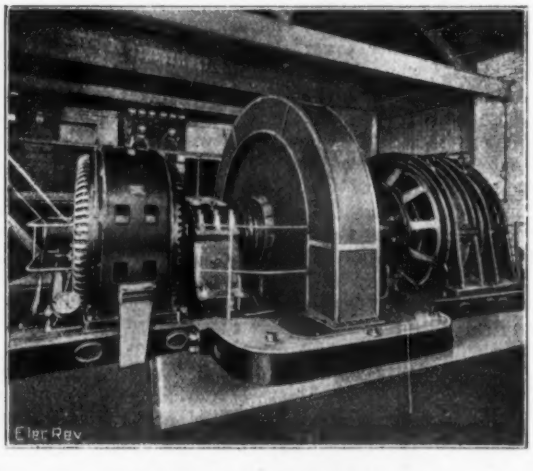

FIG. 4.—MOTOR-GENERATOR.

The plant consists, it will be seen from figs. 4 and 6 of an induction motor IM, fed with three-phase current, as indicated. The leads to this motor have interpolated in them the slip regulator and starter S R, which is controlled by the torque motor T M. The induction motor drives the generator G G, having mounted on its shaft the fly-wheel F W. The generators supply energy to the mill motor M, an overload circuit breaker O C B being comprised in the circuit. The mill motor is regulated by the controller C, established on the field circuits of the motor M, and of the exciter E. The latter is driven by a motor E M, taking its current from the D.C. circuit, as shown; S D is a safety device, and F F R is a field-forcing relay. The safety device S D consists of a circuit-breaker and no-volt coil placed in and across the generator and exciter field. Should the voltage fail from any cause, a weighted lever is released which actuates the rheostat first to insert resistance into the exciter field, and ultimately to break that circuit. At the same time the main circuit-breaker is opened. The controller C consists of an apparatus by means of which the field strength of the generator is varied between zero and full strength, at the will of the mill operator, thus raising or lowering the voltage in the main which is dependent on the strength of the generator field. The speed of the motor then follows the generator voltage. The controller also reverses the field in order to reverse the direction of rotation of the motor at the end of each pass of the ingot through the rolls. The controller consists of an arrangement of resistances which are either automatically, or by hand, cut out of the generator-field circuit after the first movement of the control lever in either direction.

At the neutral position of the operating lever there is no

field on the generator, and consequently the motor is at a standstill. When the lever is moved in either direction from the neutral or stop position, the generator field is built up, and the motor speed rises until near the end of the pass, or until the Ward-Leonard limit, or the normal full speed is reached. The time of acceleration may be shortened to any reasonable extent as described below.

If the billet is a long one, the speed of the motor is further increased by another movement of the control lever whereby resistance is inserted into the mill motor field. When near the end of each pass, the generator-field strength is decreased, and the motor and rolls are brought quickly to rest by means of the regenerative braking effect, the motor acting as a generator and driving the generator as a motor. The result is that the fly-wheel which during each pass of the billet through the rolls had dropped in speed, is again speeded up, and at the same time any surplus energy is returned to the line by way of the induction motor.

It is found with normal voltage suddenly impressed on the field of the generator that the rate of acceleration would be, in most instances, rather slower, owing to the natural lag due to self-induction, than the requirements of reversing mill work might call for. Owing, however, to the adaptability of electrical control, this sluggishness is very easily dealt with, and the acceleration increased to any desired degree, even up to such a rate as would make it impossible to handle the material. This is effected by impressing, through an electrically-limited interval of time, a voltage much higher than normal on the generator fields. It will be observed that F F R, the field-forcing device utilised for this purpose, is controlled by the rise in voltage in the main circuit between generator and mill motor, the exciter field resistance being inserted when a predetermined voltage in the main circuit is reached. It should be noted that the speed of the mill motor corresponds precisely to the changes in voltage. The effect of forcing the generator field in this manner is shown in fig. 7, together with a comparison with a normal field voltage applied to the same field. The curve is, perhaps, remarkable for showing the effect of self-induction on rather a large scale.

The following particulars relate to the equipment described in this article:—Mill motor = 2,500 H.P., R.M.S. rating; 8,500 H.P. peak; 0/40 R.P.M. with Ward-Leonard control; 40/75 R.P.M. with rheostatic control; forced ventilation with filtered air. Generators = two, 1,000 KW., 600 R.P.M. Induction motor = 1,350 B.H.P., three-phase, 40-period, 5,750 volts, 600 R.P.M. synchronous. Supply = three-phase, 40 periods, 5,500 volts. Fly-wheel = 35 tons; peripheral speed about 22,500 ft. per minute.

In designing the fly-wheel, of which full details are shown in fig. 8, the object aimed at has been to secure the greatest possible store of energy in a given weight of wheel without excessive stresses. The wheel is solid throughout.

A complete duplicate system of centrifugal fans, with filters for the forced ventilation of the motor, also duplicate sets of oil pumps with tanks for the forced lubrication of the bearings of the fly-wheel motor-generator set, are provided. With regard to the latter, it may be remarked that, as a test, the set has been run for a long period under observation, without using the forced lubrication. Throughout the test there was no undue rise in the temperature of the bearings, and, indeed, forced lubrication is installed more as a reserve in case of an emergency than as a necessity. One pump is, however, kept running constantly.

A second motor-generator fly-wheel set is at present being erected, together with a similar motor to that here described, designed to drive a reversing finishing mill adjacent to the present cogging mill. The new motor-generator set will be coupled to the existing set, although it can, if necessary, be run as a separate unit. Later, an additional pair of generators will also be coupled up, and will operate a third mill motor. Fig. 9 shows, in outline, the whole composite fly-wheel set as it will be when completed. The total overall length will then be about 85 ft., and the set will comprise two induction motors and six generators with two fly-wheels, the whole designed for driving three reversing mill motors.

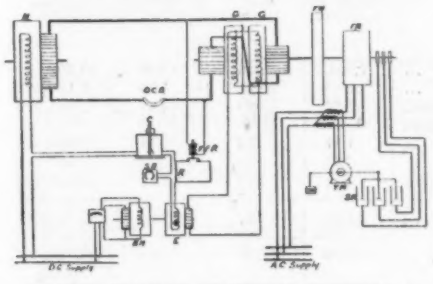

FIG. 6.—DIAGRAM OF MILL CONNECTIONS.

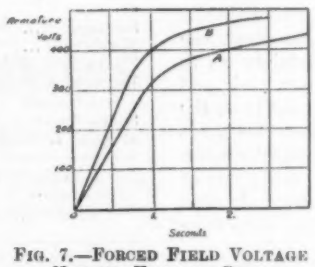

FIG. 7.—FORCED FIELD VOLTAGE AND NORMAL VOLTAGE CURVES.

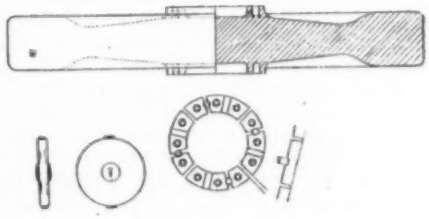

FIG. 8.—DETAILS OF FLY-WHEEL.

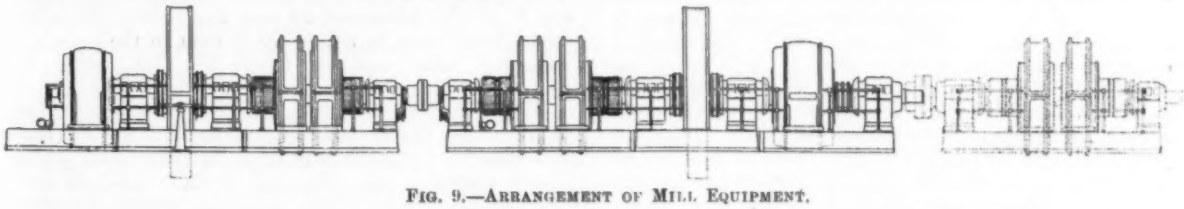

FIG. 9.—ARRANGEMENT OF MILL EQUIPMENT.

In conclusion, our thanks are due to Messrs. Palmers, and the various firms mentioned which have supplied plant, for permitting the publication of the above details and illustrations.

A New Heat-meter.—Difficulty having been experienced in computing the amount chargeable to individual occupiers of houses or flats when these are supplied with heat from a central installation, a new heat-meter has been introduced by Mr. Hans Henrichsen, of Hellerup, Denmark. It consists of three thermo-electric couples in boxes, two of which are attached to the radiator and the third fixed on the wall of the room. The temperature difference between the radiator and the wall produces a feeble electric current which is recorded by integrating mechanism, the radiators from each consumer being connected in series to the integrating meter. Careful trials at the Copenhagen Public Testing Station have shown that the current produced is very nearly proportionate to the amount of heat radiated. The error of the meters submitted amounted in a few cases to 5 per cent., but was frequently substantially less. The meters are carefully made, all thermo-elements being constructed of nickel and copper wire firmly attached to the conducting wires, which have the appearance of armoured cables. The heat elements are enclosed in strong boxes having soldered joints to prevent all interference and a layer of non-conducting material to prevent radiation. The heating elements of the radiators are fixed behind by an ornamental holder and are hardly noticeable. Meters of this type were used last winter in central heating installations in Denmark and were found eminently satisfactory.—*Technical Review.*

ELECTRICITY IN MINES.

In our issue of January 16th, we gave some extracts from the general report of H.M. Chief Inspector of Mines, regarding the growth of the use of electrical plant in and about mines, and also referred to the fatal accidents, which, unfortunately, increased from two in 1917, to six in 1918, below ground. There was also one fatal accident on the surface, making seven deaths in all from this cause.

It is, however, satisfactory to learn that, in spite of all the difficulties created by the war, the use of electricity did increase by 5·66 per cent., and we have reason to believe that were the coal mines once handed back to the coal owners, very great and costly developments would be put in hand at once, many of which would be in relation to electrical plant. The North of England collieries, especially—where a bulk supply of electricity is available—appear to be gradually, but surely, replacing their old plant with new machinery driven by electricity. At present, however, the coal trade is being strangled with the uncertainty as to what is going to happen; and vast development work, and schemes of reconstruction which would greatly facilitate the better production of coal, are being held up. The great importance of this is recognised by the chief inspector when he says:—"In order to increase output, more machinery of the latest type, especially in connection with mechanical auxiliary haulage, should be introduced to replace the more costly systems by horse and by hand.

"Electrical apparatus and machinery, either not proceeded with at all, or long delayed through the prior claims of the war, should now be readily procured. In this respect it is well worth consideration whether the coal industry should not be given precedence over other industries in order to increase the output of coal." Everyone will, without doubt, cordially agree with these remarks of the chief inspector, especially when one realises that:—

"Development such as boring, sinking, and the driving of tunnels and cross-measure drifts to open out new seams practically ceased during the war, and in consequence, many of the pits will be seriously affected for some considerable time to come. The present state of the mines is necessitating, and will continue to require, a large amount of unproductive labour for a considerable time before the mines are upon a satisfactory peace footing." With regard to haulage machinery, it is important to notice that 62,775 horses and ponies were employed underground during the year, most of which could probably be replaced by electrical haulage machines, with very much greater efficiency, to say nothing of releasing these animals from what must always be a more or less dangerous employment. From this point of view, it may be interesting to note that during the year, 2,812 died either from injury or disease; 2,537 had to be destroyed for the same reasons; 7,992 suffered from injury, and there were 231 reported cases of ill-treatment.

While the use of coal-cutting machines slightly extended, there being, in 1918, 695 collieries where coal-cutting machinery was employed, against 678 in 1917, it is interesting to note that the output of mineral obained by these machines was reduced by no less than 322,840 tons; the output in 1917, from 3,799 machines, being 28,196,486 tons, and in 1918, from 4,041 machines, only 27,873,646 tons. Of these machines, 1,797 were driven by electricity, and 2,244 by compressed air, but of the latter 1,370, or more than half, were "percussive" type machines, which are mainly used in "heading" work. Of the "longwall" machines, by far the most popular appears to be the "disk" type, there being a total of 1,259 machines of this kind, against 595 "bar" type, and 791 "chain" type. Further, of the "disk" machine, 859 were driven by electricity, as were also 468 "bar," and 460 "chain" type machines. Scotland still holds the blue ribbon for coal-cutting machinery, having a total of 1,081 machines, 946 of which are electrically driven. The Yorks and North Midland Division follows with 882 machines, 429 of which are electric; the Northern Division, 860 machines, only 151 of which are electrically driven, but of the remainder 619 are "percussive" compressed-air driven machines; Lancashire and North Wales Division, 691, of which 399 are "percussive," and only 53 electrically driven; South Wales 156, with 58 electrically driven, 98 compressed air, of which 31 are "percussive"; and Midland and Southern 371, which includes 160 electrically driven, and 211 compressed-air machines, of which 117 are of the "percussive" type. The following table, however, well illustrates the superiority of the electrically-driven machines, and shows the output obtained by the machines in the various inspection divisions.

Output of Mineral Obtained by the Use of Coal-Cutting Machines.

Division.	Total number of machines.	Worked by Electricity.	Worked by Compressed air.	Mineral obtained. Tons.
Scotland	1,081	946	135	10,202,131
Northern	860	151	709	4,139,197
York and N. Midland	882	429	453	7,481,218
Lancashire, N. Wales and Ireland ...	691	53	638	2,682,063
South Wales ...	156	58	98	823,804
Midland & Southern	371	160	211	2,545,233
Total in 1918 ...	4,041	1,797	2,244	27,873,646
Total in 1917 ...	3,799	1,739	2,060	28,196,486

It will be noticed that over one-third of the total output was obtained from the Scotch coal mines, which have only 135 machines driven by compressed air, and of these 33 are of the "percussive" type. Also, with regard to the total output, we must notice that the reduction is not due to less "coal" being cut by electrically-driven machines, as this really increased from 16,081,034 tons in 1917 to 16,204,653 in 1918; but from compressed-air machines the output was only 11,118,327 tons in 1918, against 11,545,264 in 1917.

We also note with regard to electric safety lamps, that these increased in the year 1918 by 9,870, making a total of 156,521, of which 142,969 are magnetically locked; and it is also interesting to note that 10,730 fewer oil safety lamps were in use in 1918 than in the preceding year, the total numbers being (in 1918) 590,185; 24,761,030 shots were also fired by electricity.

With regard to output, the Chief Inspector says: "The output of coal was reduced from a total of 287,411,689 tons in 1913 to 227,714,579 tons in 1918; the latter is the lowest output since the year 1902. In 1902, 824,791 persons produced 227,084,781 tons." The total number of persons employed at coal mines in 1918 was 994,317, of whom 210,771 were females employed above ground; 199,551 were males employed above ground; and 783,546 were males employed below ground, 57,688 of whom were boys under 16 years of age.

Prosecutions.—There were two prosecutions under the General Regulations relating to electricity; one in which the manager and electrician of a Nottingham colliery were prosecuted for (1) Under 123 (*b*)—the use of inflammable material in the construction of a motor house; (2) under 124 (*a*)—cable-joint boxes not so installed as to prevent danger, so far as was reasonably practicable; (3) under 120 (*f*) (*i*)—cable in main switch-house at shaft bottom not mechanically protected; (4) under 129 (*f*) (*ii*)—insulating material at cable ends in motor house not efficiently sealed; and (5) under 134 (*c*)—adequate precautions not taken to prevent signal and telephone wires at shaft bottoms from touching power cables. The result of the trials was that the manager was fined on (1), (3), and (4), and charges (2) and (5) were dismissed.

With regard to charge No. 2, the fact was that high-pressure joint boxes were slung from the roof by comparatively thin rope. This is an insecure method of fixing a cable-joint box, for if a box falls there is a risk of a broken joint and a heavy flash, and serious accident to the persons employed. More than 90 per cent. of the joint boxes in the pit were so slung; but the manager, after the hearing of the case, undertook to have all high-pressure joint boxes securely supported from below.

The manager of a Yorkshire colliery was prosecuted for contraventions of General Regulations 128 (*c*) and 123 (*b*), in that (1) efficient means to prevent danger were not provided for cutting off all the pressure automatically from the part of an electrical system in the event of a fault, and (2) inflammable material was used in the construction of a haulage motor room containing electrical apparatus. It is quite clear that every sub-circuit should have its own separate protection, and in neglecting to provide fuses or cut-outs in the circuit, an underground fire occurred which might have had serious results. A conviction was obtained on the the first charge, and the second was withdrawn on payment of the costs. The fine and costs amounted in all to £19 2s.

Surely it is time the responsibility for electrical apparatus in and about mines was taken off the shoulders of the colliery manager, and given to properly qualified and certificated engineers.

THE TORQUE OF TOOTHED ARMATURES.

BY LAURENCE H. A. CARR, M.Sc. (TECH.)

WITH a toothed, or slotted armature, most of the flux passes through the teeth, and the flux density in the slot itself is low.

This has led to the theory that the torque on the conductors is proportionately lower than would be the case with a smooth-cored armature carrying the same flux, since the product of current and flux density across the conductor is much smaller.

The balance of the torque on the armature is said by the exponents of this theory to be due to the magnetic pull between the teeth and the pole-face, the flux arranging itself with the correct tangential component, due to distortion, to give the observed result.

On the other hand, since there is no transformer action between the field windings and the armature windings, all the power input to the armature conductors (in the case of a dynamo) is mechanical, and this must, by the law of conservation of energy, be equal to the electrical power output (plus losses, if any).

In other words, the full torque of the machine must come on the armature conductors, this torque being that corresponding, not to the flux density at the bottom of the slots, but to the average air-gap flux density. In order to be convincing, however, the apparent paradox must be explained; in other words, the fallacy of the "reduced torque" theory must be fully exposed.

As in all such cases reference must be made to first principles, and here is the crux of the whole question.

There is no fundamental force of attraction between a given current, and a field strength of given flux density which can be defined as a first principle.

Maxwell* states that: "Any displacement of the electric surface (equivalent to a magnetic shell which has previously been considered) will be aided or resisted accordingly as it increases or diminishes the number of lines of induction which pass through the surface in a positive direction."

In other words, the magnetic pull is determined by the rate of change of flux, with reference to change of position, and electromagnetic pull is, and can be only, defined in this manner.

The usual formula for the pull of a conductor carrying current is based on the above definition, and in its simplest form may be written:—

$F = I\,l\,B$, where F is the force in dynes; I is the current in absolute units; l is the length of conductor in centimetres; B is the density of the magnetic field.

From the previous argument it follows that this is only true of a uniform field, since B in the above equation really represents $d\Phi/dx$, the rate of change of flux (Φ), with regard to the change of position of the conductor (x). If this equation be now applied to the toothed armature, it will at once be seen that it is wrong to take the flux density at the bottom of the slot, since the value of B there is no longer equal to $d\Phi/dx$.

Herein lies the fallacy in the "reduced torque" theory. As long as the armature and conductor move together, $d\Phi/dx$ has the same value as it would have in the case of a smooth-cored armature, since the conductor cuts the same total flux in any given time.

If, however, a slotted armature be set stationary in an excited field, and a loose conductor be placed in the centre of a slot, the conductor will not show the full normal torque, for as long as it moves along the bottom of the slot, without moving the armature, the value of $d\Phi/dx$ only corresponds to the actual flux density at the bottom of the slot. Similarly, the E.M.F. generated will only be low, corresponding to the low flux density.

As soon as the conductor moves, or is moved, into such a position that further movement turns the armature core, the torque and E.M.F. immediately rise to their full value, due to the apparent movement of the flux across the slot, which commences as soon as the armature begins to move.

* "A Treatise on Electricity and Magnetism," Vol. II, p. 137.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electric Welding.

Can any reader give information with regard to the protection of operators' eyes by using goggles instead of screens with electric welding apparatus?

The screens appear to be very clumsy, as they prevent the operator using both hands; also it is impossible to see the job through the screen until the arc is struck.

Are there no goggles on the market similar to those used with acetylene welding plant, through which one can see the job before striking the flame?

R. A. Jones.

Shoreham-by-Sea.
January 19th, 1920.

[Not only the eyes, but also the face, neck, hands, and arms must be protected from the rays of the arc. Inquiries of this kind are usually answered by post; we insert this because it is typical of many such queries relating to matters which have been fully dealt with in our pages. This subject, for example, was discussed in the following issues of the ELECTRICAL REVIEW: November 1st, 1918, p. 414; December 20th, 1918, p. 612.—EDS. ELEC. REV.]

"A Red Rag to John Bull."

You do me the honour to refer to a letter of mine to *The Times* in which I identify world enlightenment with world peace, and express the view that without the one the other is impossible. You kindly exonerate me from responsibility for certain utterances by two American commercial men—Montague and Steenbohm by name—calculated to cause bitterness between British and American manufacturers and traders. You suggest the use of my "newspaper influence" against "indiscretions" inimical to what you generously term my "noble sentiments."

Of course, outbreaks such as those of Montague and Steenbohm—I assume they are correctly quoted—are not preventable. But editors either can refrain from publishing their remarks or can accord them the derision they deserve. If I had any "newspaper influence," or influence of any other sort, I should use it to dissuade editors and all other persons with access to the public mind from playing the game of mischief-makers, and catering to the vanity of fools, by giving the wrong kind of advertisement to what they say.

Montague is reported as foreshadowing the obliteration by Americans of foreign opposition in foreign markets. Who does not recognise on the instant that this is merely ignorant and arrogant bombast? And Steenbohm's idea (note the name) of bleeding the foreigner. Could economic idiocy go further? These gentlemen, unless victims of misrepresentation, appear to have a type of intellect not to be found this side of the Stone Age. England is our best customer, as we are hers. Fine business it would be—would it not—for us to impoverish her, or her us?

I gather from your article, "A Red Rag to John Bull," that certain New Zealanders do not like the Act of the American Congress permitting American trade combinations for purposes of foreign commerce. Such combinations are necessary for such purposes. Britain has many of them, the most experienced and powerful in the world. France has them. All countries who deal largely abroad must have them. As a matter of fact, America is far behind the international procession in this respect.

Do we squeal?

We do not. We do not begrudge the British peoples a single honest penny they can make. We want to see them prosperous, we want to see France prosperous, we want to see every nation prosperous. And why? Well, for this reason, if for no higher: only in a prosperous world can we be prosperous. Those who think we care for nothing but dollars, if they can believe we are *intelligent*, will realise at once why, far from wishing to cripple other nations economically, we wish them to be abundantly prosperous. Just a free field, and no favour; no jockeying; no arbitrary, forcible, explosion-maturing methods—these are what, and all, Americans want.

Edward Price Bell.

Chicago Daily News,
London Bureau, *January 23rd*, 1920.

Electricity Supply.

I have carefully read your editorial comment with reference to the above, and it appears to me that you are rather hard on the contributor to *The Times Trade Supplement*.

Whilst the portion of the Electricity (Supply) Bill referred to as the second part does not of necessity do away with the autonomy of the companies, it certainly seems to me that it would provide all the power necessary to do so, and, therefore, justifies the contribution which you censure.

Quite apart from the question whether the policy of the original Bill would or would not be in the real national interest, there can be no question but that the District Board proposition is, from the company point of view, quite different from that of the Joint Electricity Authority; in the one case the Board is independent of the companies and set over them, whilst under the present Act the latter become, voluntarily, part and parcel of the J.E.A., and have an autonomy denied in the event of a District Board being imposed upon them.

It seems to me that this is the reading accepted by the Association's representative of the industry. The fight on the Bill, as I understand it, was on this very point, namely, that District Boards did away with the autonomy of the companies (and municipal undertakings also).

As to Joint Electricity Authorities being first allowed, we have to remember that even if they were formed it was possible under the old Bill to substitute District Boards at the will of the Electricity Commissioners.

J. Herbert Edwards,
Managing Director, Stroud, and other Electric Supply Companies.

Stroud, Gloucester, *January 20th*, 1920.

[We refer to this matter in our leading columns.—EDS. ELEC. REV.]

The "Lesco" Lampholder.

In reply to Mr. Hope's letter, may I make it clear that the criticism of the "Lesco" holder, in my first letter, is that the small indentations on the top part of the holder appear to me to be insufficient to carry the weight safely. I intended to say that the top part of the holder should be cast, and I did not refer to the bottom part, which I agree is made on normal lines.

Mr. Hope states that the top part of the lamp is made from a tube, and not from a stamping or spinning. Personally I do not think this makes much difference. If the metal of which the top part is made is too thin, then it does not seem to matter whether it is a stamping, spinning, or a tube. To save possible misunderstanding, I suggest that Mr. Hope gives the thickness of the metal of which the top part of the holder is made—I mean the metal having the small indentations. If Mr. Hope will give this in thousandths of an inch, I will be glad to carry the discussion further.

My own impression is that, if the method of carrying the holder is improved, the lampholder will be made into quite a good one, and my object in starting this correspondence was to bring about this improvement.

I may add that I wrote the manufacturers of the "Lesco" stating that I proposed to initiate a correspondence on the holder in the REVIEW. I have sent a copy of this letter to Mr. Hope, so that I trust that his answer relating to the thickness of the metal will appear in next week's REVIEW.

C. Turnbull.

Electricity Works,
North Shields. *January 22nd*, 1920.

Mr. Turnbull having sent me a copy of his letter to you, desires that I should reply to the same in the same issue of your paper. He narrows his criticism down to the strength of the small indentations in the top part of the holder, which he says appear to him insufficient to carry the weight safely, and he asks me to state the thickness of the metal used in this holder.

The thickness of the metal used is .032 in., and I am now able to give the strength of the indentations in question. The test consisted in adding weights to the bottom portion of the holder to find out at what weight the indentations would give way. The breaking point was arrived at when the holder was carrying 258 lb.; with this weight the projections were sheared off.

I do not think any further comment on my part is necessary, and I think that this test is sufficient to show that Mr. Turnbull's fears are quite groundless.

Vernon Hope.

Manchester.
January 23rd, 1920.

Civil Engineers' Registration.

I am instructed to inform you that an executive committee of the Society of Engineers, appointed to deal with the above matter, passed the following resolution on the 19th inst.:—

That this Society cordially approves the principle of the registration of engineers, but joins with other objectors in opposing the Bill promoted by the Institution of Civil Engineers on the following grounds:—

1. Though in the broad sense in which the Institution of Civil Engineers interprets its charter, professional engineers in all branches would be included in the term "civil engineer," it is nevertheless a fact that the term "civil engineer" is employed in a restricted sense, and is so used and understood by the public, by the universities, by technical schools, and by the engineering world in general. As the usage is at present, the title amounts to a misdescription.

2. This Society objects to the Institution of Civil Engineers being the sole body to determine who are to be placed on the register. The Institution of Civil Engineers, though a competent authority as regards its own members, has no mandate from the engineering profession as a whole to act on its behalf, and the determining body should be representative. Such a body should consist of members elected by the leading engineering institutions and societies, and of certain members nominated by His Majesty, much on the same lines as the General Council is appointed to regulate the qualifications of practitioners in medicine and surgery under the Medical Acts.

Alfred S. E. Ackermann.

Westminster.
January 20th, 1920.

Awards Delayed.

I was very interested in "C. R.'s" letter regarding the L.C.C. tramways and recent awards, but would like to inform him and your readers generally, that nothing else can be expected if the Government itself does not recognise its own awards. The War Office has not yet applied the E.P.E.A. award of last March to members of its power station staffs, neither has it applied the 5s. advance of last November either to members of the A.S.E. or otherwise. Does the War Office think that the cost of living has only gone up to others than its own civilian staffs? It is now 18 months since we received a paltry advance in salary, and all our applications for advances or awards are either consigned to the waste-paper basket or put in pigeon-holes bound up with great quantities of red tape. I maintain that the War Office as part of the Government should be the first to put all awards into execution at once, if only to set an example to other employers.

W.O. Electrical Staff.

January 25th, 1920.

Electric Cast-steel Chain Cables.—With the greatly increased output of ships in America, the shortage of chain cables and wrought iron suitable for their manufacture was necessarily much accentuated. In March, 1918, Lloyd's surveyors at New York reported that an American company had developed the manufacture of electric cast-steel cables, and had submitted samples of four different sizes to very severe tensile and shock tests, the results showing the tensile strength to be from 73 to 93 per cent. over that required by the statutory tests for iron cables, and the resistance to shock being still greater than these proportions. The results being so satisfactory, the surveyors recommended that sanction should be given for the use of such cables, which recommendation was subsequently approved, as a tentative arrangement, with a schedule of tests to be used in the case of cast steel cables of considerably greater severity than those applicable to iron cables, and such cables so tested have since been accepted for use in vessels classed by this society. All cables for British vessels are tested in accordance with the provisions of the Anchors and Chain Cables Act. The Act provides that any test approved by the Board of Trade as a test equal or superior to either the breaking or the tensile test specified in the schedule may be substituted for that test by order of the Board, and the committee has now received an intimation from the Board that the testing procedure above referred to will be sanctioned for application in this country, if the occasion should arise in the near future. An experimental stud-link cast steel chain cable made in Sweden has recently been forwarded to this country for the purpose of being crucially tested at one of the public proving houses under the society's control.

THE PHYSICAL SOCIETY'S EXHIBITION.

(*Continued from page* 122.)

THE FOSTER INSTRUMENT CO. showed an improved type of fixed-focus radiation pyrometer, with an arrangement for ventilating and cooling the front portion of the receiving tube (fig. 11). It is also fitted with a sighting mirror, enabling the pointing of the receiving tube to be verified, where the working distance is long or the hot body is small. The mirror which receives and focuses the radiant heat is mounted in a special cell which can be removed from the tube. A fixed housing is also provided for use when the pyrometer is to be

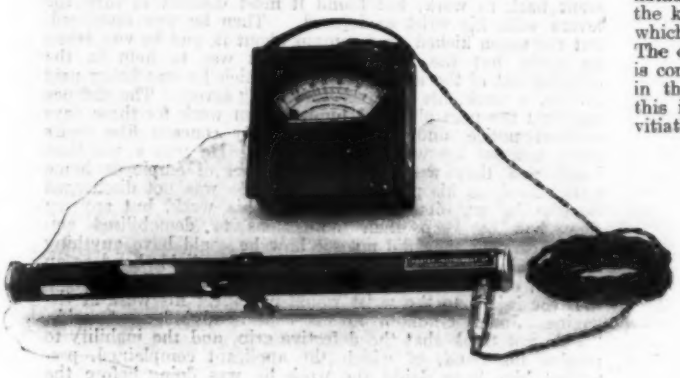

FIG. 11.—FOSTER PORTABLE PYROMETER.

continuously attached to the furnace wall (fig. 12), the standard tube being interchangeable with the housings, so that several of the latter can be provided in different positions. A closed-end refractory tube can be fixed to project into the furnace. Various thermo-couples (of the Hoskins alloy) and pyrometers were shown, as well as impact testing machines.

THE DUBILIER CONDENSER CO., LTD., had on view a selection of high- and low-tension condensers suitable for use in wireless transmitting and receiving. These condensers were similar to those shown at the British Scientific Products Exhibition.

THE CONCORDIA ELECTRIC WIRE CO., LTD., had a show case of bare and covered instrument wires, including copper and resistance alloys covered with various materials for use in electric magnets and other similar devices.

THE IGRANIC ELECTRIC CO., LTD.—This exhibit comprised the "Leesona" electric coil-winding machine, together with sample coils as shown at recent engineering exhibitions, and also samples of a lockout switch or panel, counter E.M.F. starter, electric vacuum flask, &c.

MR. F. HARRISON GLEW exhibited radio-active substances and apparatus for detection and measurement. Demonstrations of the properties and uses of radium were given at intervals, and radium luminous compound, the many applications of which need not be gone into, as well as luminous gun sights and other instruments were on view.

MESSRS. A. GALLENKAMP & CO., LTD., exhibited scientific apparatus for the heat treatment of metals, including new apparatus designed by Mr. C. R. Darling. The furnaces which were shown in operation, being electrically heated, were similar to those seen at the recent engineering exhibitions, and were described in our pages at the time.

THE CAMBRIDGE & PAUL INSTRUMENT CO., LTD.—This exhibit consisted of a selection of finely made and finished scientific instruments. The new electrical CO_2 recorder enables the percentage of CO_2 in flue gases to be determined by an electrical method, which does not involve the use of any chemical absorbent; moreover, while the portion of the instrument through which the gases actually pass can be placed in close proximity to the flue, the recorder may be some considerable distance away. The method employed for measuring the percentage of CO_2 is one devised by Dr. G. A. Shakespear, of the University of Birmingham, for testing the purity of gases. The composition of the flue gas is compared with that of air by means of a katharometer consisting of two identical spirals of platinum wire contained in two cells drilled in a copper block, each of the spirals being connected to form one arm of a Wheatstone bridge circuit. If a fairly large current is allowed to flow in this circuit the two spirals become heated and lose heat to the walls of the cells. The rate of cooling depends on the thermal conductivities of the gases in the cells, so that if the two cells contain gases of different conductivities the two spirals will cool at different rates. The difference in temperature of the two wires will cause a deflection of the galvanometer, the extent of the deflection depending on the difference in conductivity of the two gases. If, therefore, one cell of the katharometer contains a pure gas and the other the same gas mixed with some other constituent, the extent of the deflection will be an indication of the amount of the second gas present, and the galvanometer can be calibrated to show directly the percentage composition of the mixture. The difference in conductivity between air and carbon-dioxide enables the method to be employed to determine the percentage of CO_2 in flue gases. Fig. 13 shows the katharometer and water aspirator, which are enclosed in a metal case with a glass door. H is the katharometer screwed into the chamber K; the open cell of the katharometer communicates with this chamber, through which the flue gases are drawn by the water aspirator E. The other cell of the katharometer, which is filled with air, is connected to the tube F containing water, so that the air in the katharometer cell is kept saturated. The object of this is to prevent the water vapour in the flue gases from vitiating the readings, as it would do if the flue gases were

FIG. 12.—FOSTER PYROMETER IN FIXED HOUSING.

compared with dry air. When the gas in both cells is saturated with water vapour the effect of the latter is the same on both sides, and the readings are not influenced. Owing to the nearly equal conductivities of air and carbon-monoxide the presence of the latter gas does not affect the readings. To the screwed plug G is attached a filter box of glass wool

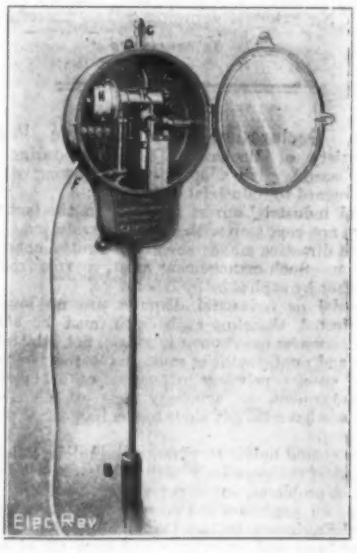

FIG. 13.—CAMBRIDGE ELECTRICAL CO_2 RECORDER.

for cleaning the gas which passes into the katharometer; D is the water inlet to the aspirator, and the pipe carrying the gas from the flue is connected to the tube C. A soot filter should be inserted between the flue and the tube C, and at the lowest point of the pipe a T-piece with its end dipping under water should be provided as a drain for condensed

steam. The U tube on the front of the aspirator is half filled with water, and when the aspirator is not working the water level in this tube will be quite steady, and will indicate the chimney draught. The water flow regulator B is designed to give maximum efficiency in the working of the aspirator;

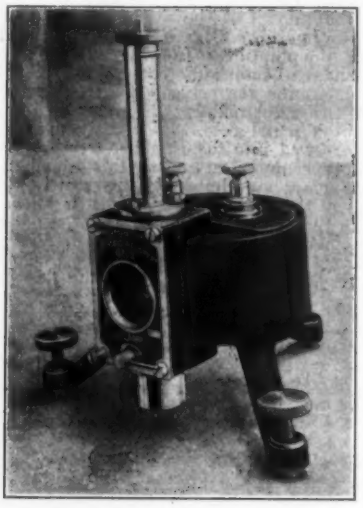

FIG. 14.—CAMBRIDGE GALVANOMETER.

the flow is adjusted until water runs freely out of the fine tube at the bottom, and only trickles out of the wider overflow pipe. The water consumption is about five gallons per hour. The records are obtained by means of a thread recorder, which consists essentially of a suspended coil galvanometer in which the pointer is depressed by means of a clockwork mechanism at intervals on to a thread impregnated with ink, which passes above the surface of a revolving drum carrying a chart. The charts are calibrated to read directly the percentage of CO_2.

The moving-coil galvanometer, shown in fig. 14, has been designed to provide a simple and inexpensive instrument of good sensitivity suitable for general laboratory work and for students' use. The coil is wound with non-magnetic, silk-covered wire on a wood former, suspended by phosphor bronze-strip from a simple torsion head, and can be clamped by turning a handle. The small metal chamber enclosing the magnet poles and the moving coil is made dust-tight. With the standard phosphor-bronze suspension the complete period of the double swing out of the magnetic field is about 6 seconds, and the deflection time when critically damped about 4 seconds. The galvanometers are supplied with the coils critically damped unless specially ordered for ballistic or other work. No external damping coil is, therefore, required.

(To be concluded.)

American Declaration on Productive Power.—The American Society of Mechanical Engineers during its annual meeting on December 4th, adopted the following declaration of principles in regard to industrial conditions :—

"Social and industrial unrest result from the fact that human relations have not kept step with economic evolution.

"Competent directive management of essential enterprises is the logical solution. Such management must be free from autocratic control, whether by capital or by labour.

"Sharp social or industrial disputes are no longer private: Society is affected, therefore such cases must be subject to the decision of authorities based upon intrinsic, not arbitrary law.

"Industry and public utilities must serve the people. There is no room for special privilege of capital or of labour. Strikes, irregular employment, or arbitrary acts of ownership or of management are harmful not alone to the immediate parties, but to society as a whole.

"Productivity and public service are absolutely essential.

"On account of the peculiarly intimate familiarity of engineers with industrial problems, our responsibility is great.

"Therefore, we, engineers and members of the American Society of Mechanical Engineers, declare that the following essentials are established by facts and experience, and urge all of our members to uphold them and invite other engineers to co-operate with us in having them unanimously recognised, viz. :

"Every important enterprise must adopt competent productive management, unbiased by special privilege of capital or of labour, and disputes must be submitted to authorities based upon intrinsic law.

"Credit capital represents the productive ability of the community and should be administered with the sole view to the economy of productive power, that is, it should be granted only to those who are able to render valuable service."

LEGAL.

WORKMEN'S COMPENSATION CASES.

JUDGE GRAHAM, K.C., gave a considered judgment in the Bow County Court, on January 21st, in the Workmen's Compensation Act claim in which Edward Hanxwell, an assistant engine driver, asked for an award of £1 a week, or £150, from the Charing Cross, West End and City Electricity Supply Co., Ltd. Mr. Barnes appeared for the applicant, and Mr. Ellis Hill was counsel for the respondents. The man was cleaning the engine pit, when the ladder fell, and he fractured his right wrist. At the time, he alleged, he was earning £4 12s. a week, and was paid 25s. compensation. Then he went back to work, but found it most difficult to turn the levers with his wrist so injured. Then he was dismissed, but the union kicked up a rumpus about it, and he was taken on again, but the work he then got was to help in the cleaning out of the street boxes, for which he was being paid £3 10s. a week, his loss therefore being severe. The defence was that the man absented himself from work for three days without notice, and a great electricity concern like theirs could not put up with men like that. He was a war-time hand, and they were having a number of employés home demobilised, so his place was filled. He was not discharged because he was incapable of doing his work, but anyway they had to keep their obligations to demobilised employés, so that they did not see how he could have anything to complain of; they could not keep an unreliable hand as an assistant engine driver. Medical evidence was called to show that the injury to the wrist would not affect his work at the engine. Judge Graham, in his considered judgment, said: "I do not think that the defective grip, and the inability to revolve his hand, of which the applicant complained, prevented him from doing the work he was doing before the accident. In my opinion, he was quite capable of doing it, and Dr. Thompson, the medical referee, agrees with me. The application must therefore be dismissed with costs."

BRITISH THOMSON-HOUSTON CO., LTD. v. CORONA LAMP WORKS.

IN the Chancery Division, on Tuesday, January 20th, Mr. Justice Sargant began the hearing of an action by the British Thomson-Houston Co., Ltd., of 83, Cannon Street, E.C., against the Corona Lamp Works, of Ascham Street, Kentish Town, N.W., for an injunction restraining the defendants from infringing their letters patent No. 10,918, and asking for damages, or an account of profits, and delivery up of any infringing articles.

Mr. Colefax, K.C., Mr. T. Hunter Gray, K.C., and Mr. Whitehead were for the plaintiffs, and Mr. A. T. Kerly, K.C., Mr. R. Frost, and Mr. J. Ewart Walker for the defendants.

Mr. COLEFAX said the patent was concerned with improvements in incandescent electric lamps, and related to gas-filled lamps in contradistinction to vacuum lamps. It was an invention which had given rise to the "half-watt lamp," and was made and worked out in the laboratories of the General Electric Co., U.S.A. It was found that by filling the lamp with an inert gas, and using either a thick or a spiral filament, a lamp could be produced of a higher efficiency than any previously put on the market. The defendants relied on various specifications of other patents which, they said, disclosed the invention now in question. It was also alleged by the defence that there was invalidity and insufficiency, and infringement was denied. They admitted selling certain lamps which, the plaintiffs said, infringed the patent, being gas-filled and with spiral filaments.

Mr. JAMES SWINBURNE, consulting engineer, said it was found that the tungsten lamp could not be made commercially under one watt per candle, and the inventor realised that if he put a suitable gas into the bulb it might stop the vaporisation of the filament, and carry away the heat. He also found that under proper conditions with a thick filament the light was increased. The result of the invention was a fundamental change in the process of lamp manufacture, which was of enormous commercial importance.

Cross-examined, Mr. Swinburne said he only knew of a very few lamps on the market without spiral filaments.

Mr. KERLY: Have you ever seen a half-watt lamp with a straight filament?—Oh, yes; but I don't know whether I have seen them commercially.

Have you ever seen any lamps with straight filaments made within this specification?—I don't remember having seen one.

Do the lamp-makers desire to have the filaments as thick as circumstances will allow?—Yes.

On Wednesday, January 21st, Mr. Swinburne was cross-examined further by Mr. Kerly, and agreed with counsel that the only way he could turn a vacuum lamp into a gas-filled lamp for the same candle power and fixed voltage was by reducing the section and also reducing the length of the filament.

The hearing was continued on Thursday and Friday.

DR. PASSMORE, consulting chemist, giving evidence for the plaintiffs, said he had considered the plaintiff's specification and the various alleged anticipations. He saw no difficulty

in comprehending the invention or in putting it into practical use. In the plaintiffs' specification were the words "in concentrated form," and he saw no difficulty in applying that alternative practically. Working in a gas, one knew that the exposure of the surface cooled the mass considerably; one wanted to expose less surface, and one concentrated mass still retaining the filament. Contrasting the filament in a lamp in accordance with the invention with that of the tungsten vacuum lamp, the range of temperature was from 2,000 deg., at which the vacuum tungsten lamp ran, to 2,500 deg.-3,000 deg., at which they could and must run in order to get the increased efficiency of the gas-filled lamp. The specification referred to tungsten or other refractory metal. At the date of the patent there were other refractory metals than tungsten, known as tantalum, osmium, and molybdenum.

MR. EDWARD ALFRED GIMINGHAM, a practical electric lamp maker, in cross-examination, said this was an advance on all previous practice. In each form of incandescent electric lamp the difficulty had been to get a low candle-power with a high voltage. So far as gas-filled lamps were concerned, improvement was still going on, and to-day they could obtain a much lower candle-power on a voltage of 100 volts.

MR. J. H. GRAY, K.C., for the plaintiffs, said sales of the patented lamps in this country could be proved to amount to 5,800,000. Addressing the Court on the conclusion of the plaintiffs' case, Mr. Gray said none of the prior documents relied on by the defendants showed a combination of gas and coiled wire. The suggestion that there was a wonderful combination or ring that controlled tungsten filament lamps had not been proved. There was a large number of patents for tungsten filament lamps, but not one of them approached the combination now invented.

MR. KERLY, opening the defendants' case, said he attacked the patent on two grounds: (1) That the ambit of the monopoly claimed was not indicated with proper definition; and (2) that when it had been ascertained that the alleged invention was as claimed, there was, having regard to the admitted public knowledge and the prior specifications, no such invention.

On Tuesday, when the hearing was resumed, Mr. KERLY said there were two quite distinct branches of the argument that he desired to press on his lordship; in logical order they were (1) meaning of the definition and the sufficiency of the claim; and (2) the subject matter. He attached the greater importance to the subject matter, but the question of the definition was a serious matter for consideration. The question whether the definition was sufficiently precise had two aspects ordinarily: the more important aspect was: had the inventor sufficiently described for a user of the patent what he proposed to do? The other aspect was: had he sufficiently indicated the limits of his monopoly so as to show what ground was left open and uncovered by his monopoly? His lordship would have to answer these questions: Was there a definite invention? If not, there was nothing to define. Was it clearly and definitely stated in the claim so as to show what was left uncovered and free and, incidentally, how to work it? Was the suggested delimitation a fair construction of the claim? Was there subject matter? Had infringement been proved? Counsel quoted law on the subject of definition, and said that for this branch of his case he could assume that there was a good invention here if it had been properly defined. He contended, however, that the inventor had claimed a bigger monopoly than he was entitled to by his supposed invention. He submitted as a general proposition which was sound and also was good law that no definition which depended upon prolonged experiments to be made by a person who desired to find its limits and then only defined the ambit for particular members of the combination claimed could possibly be sufficient for patent purposes.

The hearing was adjourned.

A.S.E. *v.* SMITH, BARKER & WILSON.

HALIFAX Munitions Tribunal, on Monday, gave its decision in this case against a firm of machine tool makers, of Halifax, who were summoned for breaches of the Restoration of Pre-war Practices Act by continuing to employ female labour in turning, fitting, and slotting operations, which before the war were done by skilled labour or apprentices. The main defence, says the *Daily Telegraph*, was that the practice of employing women was not in consequence of the war, but owing to standardisation making the work of a repetitive character. The tribunal considered that the former practice was departed from in consequence of the war; but, believing that the respondents acted in good faith, they imposed a modified penalty of £50. Notice of appeal was given.

FARRANT *v.* COUNTY OF LONDON ELECTRIC SUPPLY CO., LTD.

IN the City of London Court, on January 26th, before Assistant Judge Jackson, this case, already reported in these columns, was mentioned by Mr. W. J. LARK, the applicant's solicitor. The action had been brought by Mrs. Elizabeth Farrant, 84, Fame Park Road, Putney, against the respondents, Moorgate Court, Moorgate Place, E.C., to recover £300 as compensation for the death of her husband who was killed on May 31st at the respondents' high power sub-station at Pascals works, Streatham, when in one of the switch rooms. When the case was tried before the Deputy Judge, Sir John Paget, K.C., he found for the applicant for £300 and costs. Mr. Lark said that the respondents had intimated their intention of appealing, and notice of appeal had been lodged. But they had now decided not to appeal, and application was therefore now made for payment out of the £300 to the widow. She was the only dependent. The Assistant Judge granted the application.

LINDSELL *v.* PAIGNTON ELECTRIC LIGHT CO.

AN interesting question with regard to whether a company should charge for electricity supplied to a kinema as for power or for lighting purposes, came before the Divisional Court of King's Bench, composed of Mr. Justice Bray and Mr. Justice Bailhache, on January 23rd, upon an appeal from the judgment of the County Court judge of Paignton.

Mr. Cecil Ince appeared for the appellants, who were the Paignton Electric Light Co., and Mr. Jowitt was counsel for the respondent, who is the proprietor of a picture palace at Paignton.

Mr. INCE said that the appeal was from a judgment in favour of the plaintiff in the action which was for the return of alleged overcharge by the electric lighting company, which the plaintiff said he had paid under protest as the charge had been made for lighting instead of for power. The figures were comparatively small, but the question involved was of great importance to electric companies supplying power to kinema halls. The rate for supplying energy for lighting was 7d. per unit, while that for motive power was only 3d. The short point was whether energy supplied to a kinema hall and passed through a transformer which reduced the pressure, and which was then fed to an arc lamp used to throw the picture on the screen was supplied for lighting or for motive power. His contention, said counsel, was that it was supplied for lighting, and should be paid for at the higher rate. The contract was in the application by the respondent for the supply of electricity by the company. If he used it for lighting purposes he was to pay for it at the higher rate of 7d. per unit. The current was led to the transformer at a pressure of 440 volts, and passed out at a voltage of 60, and was used for an arc lamp.

MR. JUSTICE BAILHACHE said that if the current had been supplied direct to the lantern it would obviously have been for lighting purposes, but it was passed through the transformer to make it more useful for the purpose for which the plaintiff required it.

MR. INCE said that only one ampere was used for the film-driving machine, the remainder being used for lighting. It was one out of 35, which was a very small proportion. The company charged the whole to lighting.

MR. JUSTICE BAILHACHE: Then to the extent of 1/35 of the whole they were wrong.

MR. INCE, in reply to questions by his lordship, said that the current used to light the hall did not pass through the converter, and for it there was a separate meter. His submission was that the learned judge of the County Court misled himself by not looking at the whole process.

MR. JOWITT, for the respondent, said that it was a pure question of fact, as to how the electricity which lit the arc lamp came into existence. If it was the electricity supplied by the company used merely in a different shape then it might be said that the electricity used for lighting the arc lantern was supplied by the appellants. But the dynamo created new electricity altogether. It was mere accident that the dynamo was driven by electricity and not gas. The company's energy was used for motive power only.

Their lordships intimated that under all the circumstances it was desirable that they should, before giving judgment, see the report of the expert, Mr. Swinton, upon which the County Court judge was said to have acted.

The hearing was thereupon adjourned for the production of that report.

REVIEWS.

The Coal Consumption of Power Plants. By R. H. Parsons, M.Can.Soc.C.E., Assoc.M.Inst.C.E. Pp. 24, 5 figs. London: THE ELECTRICAL REVIEW, Ltd. 1919. Price 1s. net.

The difficulty of obtaining coal at all nowadays, not to mention the price which has to be paid for it even when it is procurable, is compelling all consumers to take far more interest than formerly in the efficient operation of their boiler plants. The present monograph appears, therefore, at a very opportune time, providing as it does a really practical method of keeping a continuous check upon the efficiency with which coal is utilised for the purposes of steam raising. What the author does, in the first place, is to show engineers how to get a definite answer, and one applicable to their own particular plants, to the following questions, viz., how much coal ought to be burnt for any particular output of energy, and how much water should be evaporated by this quantity of coal? Such knowledge provides criteria against which the actual performance on every shift can be judged, no matter what the output of the plant may be. Thus the effect of any change in operating conditions, whether intentional or

otherwise, can be immediately detected. This in itself is sufficient to bring about a rapid improvement in the economy of most plants.

The method devised by Mr. Parsons is a graphic one, so that the results appeal to the eye in a manner that mere figures can hardly do. Yet the analytical study of the graphs, as given in the pamphlet, throws a most interesting light upon the operation of a station. It is shown that the constant losses both in the boiler room and engine room can be readily determined, and that the exact quantity of coal required for any additional load that the station may be called upon to carry can be calculated. The merit of the method is that these results are obtained, not by laboriously building up estimates from first principles, but by deducing them directly from the everyday performances of the plant without the necessity of making any special experiments. The reviewer, from his personal experience, can give testimony as to the practical advantages of the method in maintaining a high boiler-room and engine-room efficiency, while the insight into the fundamental conditions of the plant which results from a study of the graphs is greater than can be obtained in any other way.

The latter portion of the pamphlet contains some very practical remarks upon bonus schemes in general, and then proceeds to describe a system of bonus payment to power-house employés in respect of efficiency of operation. Each class of workers is considered separately, and each shift also stands or falls on its own merits, so that the demoralising effect of a general bonus shared equally amongst all employés is avoided. The inauguration of any satisfactory bonus scheme on a power plant depends first of all upon the practicability of devising some method of determining the efficiency of operation of the boiler room and engine room respectively. As the first part of the pamphlet shows how the efficiencies of these departments can be definitely ascertained, the correlation of a bonus scheme with the efficiency obtained is not a difficult matter. Several schemes might be devised, but we doubt if any could be found which would be simpler and more generally applicable than that advocated in the work under review. Briefly, it consists of comparing the operating results with the standards of efficiency of the particular plant, and then increasing the workmen's wages by the same percentage as that by which they may have improved upon the standard. As the latter is essentially the average of the station performances, there is always an even chance of beating it. Moreover, while the bonus is an acceptable amount in respect of such savings as are normally possible, it works out to a limit of "double time"; which any station manager would gladly pay if one hundred per cent. of his fuel could be saved!

The bonus scheme, like the method of keeping a check upon coal and water consumption, is applicable to industrial undertakings of all kinds, and is by no means confined to central power stations. All engineers using coal should, therefore, study the pamphlet in question, for they will find it one of the most interesting and valuable little publications on power-plant economy which has yet appeared, while the experience and reputation of the author are sufficient guarantee that his recommendations are both sound and practical. It deserves, and no doubt will have, a very wide circulation.

F. D. N.

The Thermionic Valve and its Developments in Radiotelegraphy and Telephony. By Prof. J. A. Fleming, M.A., D.Sc., F.R.S. London: The Wireless Press, Ltd. Pp. xv+280. 1919. Price 15s. net.

It is very fitting that the pioneer of the thermionic valve should be the first to publish in this country a comprehensive volume dealing with the applications of a device which, by his genius, was made possible, although its practical development has been very largely shared by others.

As one reads the first chapter of his book, one recognises the same qualities, the same lucidity, the same facility for rendering simple that which is really complex, which characterises Dr. Fleming's previous works on wireless telegraphy. Its readability and the convincing style appeal first to the reader. He then appreciates the concentrated mass of information supplied.

The objects of the book are, as Dr. Fleming admits, twofold. He desires to collect and present the essential facts connected with the development of the thermionic vacuum tube. He has also found it incumbent on him to explain in detail the early history of the Fleming valve, "on account of the efforts which have been made to depreciate the author's work." This he does in an interesting manner, which embraces the discoveries which led up to the application of the unidirectional conductivity of a lamp containing a cold plate to the receiving of wireless signals. The first half of the present volume is devoted to this object, and an appendix is added, containing in detail accounts of the famous American patent actions dealing with the Fleming valve. A portion of the book is thus given a rather controversial appearance, which, however, is readily excusable. It is not desired here to provide any excuse for a revival of a controversy which perhaps has been influenced just a little by commercial considerations. The wireless community, as a whole, are a little tired of the discussion and the lack of generosity and mutual recognition sometimes shown.

Chapter I is an historical introduction. The discovery and measurements of the electron are fully described, and also the early work in connection with thermionic currents. Prof. Richardson's work is given the prominence due to it.

Chapter II describes the origin of the Fleming valve, its development and practical applications. The author points out that a common mistake is to suppose that the Fleming valve was designed to be operated as a soft valve containing ionisable gas. He remarks that he never specified the degree of vacuum, and quotes his article in *Technics* of April, 1905. He always attributed the action of the valve to electronic emission, and maintains, with considerable justification, that the result of improved methods of exhaustion does not constitute a new invention. While giving generous appreciation to the work of Langmuir, Dr. Fleming considers that the vacuum tubes of the "pliotron" class are merely more highly exhausted Fleming valves. The difference between the two is quantitative rather than qualitative. The last portion of Chapter II contains descriptions of various vacuum pumps including the Geryck, Gaede, Cosmos, and Langmuir pumps. These few pages will be of considerable interest to the technical reader.

Chapter III deals with the three-electrode vacuum tube invented by Lee de Forest. The work of Armstrong, Lieben, Reisz, and others is mentioned. A method of measuring slopes of characteristic curves devised by E. V. Appleton is described.

Chapter IV deals with the valve as a generator of oscillations. It is pointed out that Franklin's "reaction" patent (No. 13,636/13) was applied for three months before Armstrong's "regenerative" patent. Various typical circuits are shown and also methods of using the Dynatron.

Chapter V describes briefly the action of the valve as a detector. A description is given of current limiting devices developed by F. P. Swann and G. M. Wright.

Chapter VI is a very brief account of the use of the vacuum tube in wireless telephony.

Chapter VII deals with modern improvements in thermionic apparatus, and a number of amplifier circuits, continuous wave receivers, and continuous wave transmitters are described. The volume closes with a few quotations from recent theoretical papers.

Throughout the book the author gives innumerable references which are of very great use to the reader who proposes to go further into the subject. The fullest recognition is given to the work of other investigators.

The first portion of the book, especially, is of the utmost value, and one's only regret is that the "severe limitations imposed upon the size of the book" prevented the inclusion of some of the latest circuits and apparatus. The volume will receive a well-deserved success.

The format, printing, and paper of the book are of high quality, and the publishers are to be congratulated on their part in the production of the volume.—JOHN SCOTT-TAGGART.

Foster's Pocket Reference Books. Published by Frank Foster, College Road, Manchester. Price 2s. net each.

No. 1, Mechanical Engineering.—This little book of ninety-odd pages of notes and general information on mechanical engineering will be found to contain a fair proportion of matter not given in other pocket reference books. The information is concise, definite, and in most cases based on up-to-date practice and experience. The range of subjects dealt with is much wider than usual in books of this character, and includes notes and tables on cotton mill machinery, paper making, brickwork, portland cement, timber, gas producers, and a variety of other matters of general interest to the mechanical engineer.

It is rather hard to say to whom this little book would be most useful; the works manager and the consulting engineer will find a great deal of useful, practical, and reliable information. It would be an advantage if the index was enlarged for reference purposes.

No. 2, Iron and Steel Work.—This book contains 110 pages of extremely useful information, both in form of notes and tables. A good deal of the matter is original, and much of the remainder cannot be found in other pocket books. It should be of great use to all those engaged in the iron and steel industry, and can be recommended.

The following subjects are dealt with either in the form of tables or notes: Coke-oven recovery; blast furnaces, design, output, and slags; blast furnace gases; electric furnaces; blowing engines; open hearth furnaces; acid open hearth; basic open hearth; crucible steel; tool steel manufacture. The important subject of rolling mills is dealt with in detail.

No. 3, Foundry, Iron and Steel, Non-ferrous.—Again in this book we find a large amount of information not contained in the majority of pocket books. It deals with a subject of which the average moulder knows very little. The matter is condensed and written in a manner any mechanic can understand. The subjects dealt with include every branch of iron and steel moulding, the most important being: Moulding sands, core sands, pouring sands, moulds, cast iron mixtures, cupola charges, suggested standards for mixtures, steel melting, electric steel furnaces and phosphor bronze mixing. This book deserves a successful sale among all those engaged on the practical side of foundry work.

E. P.

BUSINESS NOTES.

Our Half-Yearly Index.—The Index to Vol. 85 of the ELECTRICAL REVIEW, which is now ready, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d., post free. Any reader or advertiser, at home or abroad, who requires a copy for binding, or for other purposes, is asked to make application therefor promptly to: The Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

Clearing Office (Enemy Debts).—The Controller states that the pre-war rate of exchange on Germany referred to in the Treaty of Peace, at which debts or claims against German nationals are convertible into British currency is—Marks 20.5075 equals £1—and that the calculation must be made by the creditor or debtor before preferring his claim or tendering payment of his debt. Notice is also given to debtors of German nationals for sums of under £50, who were not required under the Proclamation to register their debts with the Public Trustee, that they are required at once to pay to the Controller at Cornwall House, Stamford Street, S.E. 1, the amount of such debts with interest at 5 per cent. per annum from August 4th, 1914, except in cases where the debtor is liable to pay interest at some different rate or from some other date. Creditors in preferring their claims are requested to comply with the directions in the margin of the form of proof and circular letter which was sent to them by the Controller. It is of importance that two extra copies of the detailed particulars of the account which is endorsed on or exhibited to the proof, should be attached to it when lodged at the Clearing Office. Failure to observe this requirement will lead to delay in payment of the claim.

Spanish Government Contracts.—A translation of a complete list of articles in which foreign competition will be admitted in connection with the Spanish Government Contracts during 1920 may be consulted by British firms on application to the Latin-American Section of the Department of Overseas Trade. The *Board of Trade Journal* states that the list is divided into sections, including machinery, motors, engines and apparatus in general; electrical materials; scientific material for instruction and research purposes; material for building purposes, &c.

Continental Trade Tours.—In order to compete with the permanent samples exhibitions and kindred enterprises now in being or process of formation on the Continent, the Department of Overseas Trade (Foreign Office and Board of Trade) proposes to organise a series of British trade tours in the important commercial cities of Europe. Provided a sufficient number of British manufacturers are willing to participate in the scheme, its organisation can be put in hand immediately, as the necessary preliminaries have been completed. The undertaking would be handled on the lines of a theatrical tour—viz., movable shows visiting permanent buildings at fixed dates advertised in advance. Sites would be secured in the important Continental centres of industry, either by Consular arrangement or with the co-operation of the local Chambers of Commerce. The various trade fairs would then tour these sites, occupying roughly a month at each city, a full fortnight in actual exhibition, and the remainder in erecting, dismantling, packing, and transportation. This period would vary slightly, as shown in the following itinerary and time-table:—

	Open for		Open for
Amsterdam	2 weeks.	Barcelona	2 weeks.
Brussels	2 weeks.	Marseilles	2 weeks.
Amiens	1 week.	Genoa..	2 weeks.
Paris	2 weeks.	Naples..	2 weeks.
Bordeaux	2 weeks.	Athens..	2 weeks.
Lisbon	2 weeks.	Constantinople	2 weeks.

At the outset there will be four exhibitions starting at intervals of four weeks. The work of advertising, publicity, and issuing invitations to the right class of buyers and of the public would be undertaken by our Trade Commissioners and Commercial Secretaries. Particulars of costs and regulations are not yet available, but will be issued shortly.—*Board of Trade Journal.*

The New Italian Tariff.—The proposed new Customs tariff in Italy is now under the consideration of a Parliamentary Committee. It was prepared under the auspices of the late Government, and is of a highly protectionist nature, a special differentiation being made as between goods from late enemy countries and those from Allied and other nations. It cannot be foreseen what alterations, if any, the tariff will undergo under the new Government. As projected, however, the duty on steam marine engines, which in the old tariff amounted to 6 lire per cwt., is put at 9½ lire per cwt. in the general tariff, whereas such engines of German or Austrian origin are to be subject to a rate of 56 lire per cwt. The same rates also apply to steam engines of all kinds.

An A.E.G. Extension.—The Berlin A.E.G., whose cable factory adjoins the Oberschonweide engineering works, proposes to acquire the latter for a sum of 7,500,000 marks. The works, which is closely associated with the Ludwig Loewe group, was formerly known as the German Niles machine-tool works.

Industrial Tendencies in Germany.—*Deut. Allg. Ztg.* states (according to the *Economic Review*), that Messrs. Ludw. Loewe & Co., of Berlin, are increasing their capital by Mk. 5 mill., "in view of the increased costs of production and the decline in the workers' efficiency."

Industrial League: Change of Offices.—The Industrial League and Council has moved into larger premises at Grosvenor Mansions, 82, Victoria Street, S.W. 1.

Prices of German and Swiss Electrical Securities.—The *Deut. Allg. Ztg.* gives the following fluctuations in shares on the Berlin Bourse during December:—

	Dec. 1st.	Dec. 13th.	Dec. 19th.	Dec. 31st.
Deutsch-Ueberseeische Elektrizitätsgesellschaft	812	675	560	915
A.E.G.	240	249·75	230	243
Schuckert	147·60	141	140	151
Siemens u. Halske ...	243	255	255	271

The following falls in Swiss shares on the Zurich Bourse during 1919 are reported by the *N. Zürcher Ztg.*:—

	Dec. 31st, 1918.	Dec. 31st, 1919.
Electrobank, Zürich	880	260
Aluminium Ind. Ges.	2,790	1,790
Brown-Boveri A.G.	1,460	1,220

—*Economic Review.*

Postage on Catalogues.—We mentioned in a leaderette last week the folly of under-stamping foreign trade correspondence and catalogues. The instance there quoted is now followed by a similar error in sending catalogues to Canada. The *Board of Trade Journal* says that H.M. Trade Commissioner at Ontario has received complaint from a Canadian Steel Corporation that United Kingdom firms *continue* to send them printed matter insufficiently stamped. *The Corporation will decline to accept such in future.*

Bankruptcy Proceedings.—*Re* ERNEST BOHM, electric lamp manufacturer, 5, Boxworth Grove, Barnsbury, N.—This bankrupt, who failed in July, 1907, applied at the London Bankruptcy Court on January 22nd, for an order of discharge. Mr. Garton, Official Receiver, reported that the applicant, a German, came to England in 1880, with £15 or £20, and from 1883 till November, 1903, carried on business in London. In 1901 he patented a form of electric lamp, and in November, 1903, he agreed to assign his interest in the invention to a firm of accountants, who had provided money to pay off a mortgage on behalf of a company which they undertook to form to acquire the patents, and in which he was to have received certain shares. The bankrupt was subsequently employed in the manufacture of the lamp at the company's premises till April, 1904, but was then dismissed, and shortly afterwards commenced proceedings for specific performance of the firm's agreement to form a company. In February, 1905, Bohm's Lens Lamp Co., Ltd., was registered by the firm, but the bankrupt never received any shares therein. During August, 1905, in anticipation of an arrangement being come to with the firm, the bankrupt sold his interest in the invention to B.N.C. Syndicate for £683, payable as to £150 in cash, and the balance in shares of the syndicate, which undertook to form a company with a capital of £60,000, to acquire and exploit the patents. On the formation of this company, he was to have received £850 in cash, and £17,500 in shares. In December, 1905, Lens Lamp Co., Ltd., was registered, but never went to allotment. During the following April, proceedings were commenced in the Chancery Division against the bankrupt and the syndicate, by Mr. Sheffield Neave (the petitioning creditor), who claimed to be absolutely entitled, in the events which had happened, to the said invention and patents, and as the result of those proceedings, judgment was given for the plaintiffs in November, 1906. During the previous May, the bankrupt had commenced an action in the King's Bench Division against the petitioning creditor and others, claiming damages for fraud and breach of contract, but he was unable to carry through that action owing to lack of funds. He attributed his failure to inability to realise his interest in the invention, to liability for law costs, and to excess of expenditure over income. The offences alleged by the Official Receiver were: (1) Insufficiency of assets to equal 10s. in the £ on the amount of the unsecured liabilities; and (2) omission to keep proper books of account. The bankrupt's solicitor asked for the discharge to be granted subject to judgment for £15. He pointed out that it was a very old case, the receiving order having been made in 1907. The bankrupt was an old man, and wished to be relieved of the stigma of bankruptcy. It was true he was a German, but he had been in this country most of his life; he had married an English wife, and his two sons had served in the Army on the English side. Mr. Registrar Hope granted an order as desired, remarking that the money must be paid into Court before the discharge would become effective.

M. B. MOUNTAIN (Economy Appliances and Engineering Co.), engineer, lately at 66, Victoria Street, London, S.W.—First and final dividend of 4s. 9d., payable by Saher & Davis, 28, Theobald's Road, W.C. 1.

The A.S.E. — The *Daily Dispatch* (Manchester) states that a delegate meeting of the Amalgamated Society of Engineers is being held in London to hear the report of the deputation sent to America to negotiate with the International Association of Machinists on the basis for bringing both organisations together. The proposals to be submitted are that the A.S.E. shall cease to operate as a labour organisation in the United States, and shall transfer into the International Association of Machinists all members enrolled in the books of the American branches; also that the International Association of Machinists shall cease to operate in Canada for a period of 10 years, and shall transfer in a body its entire Canadian membership into the A.S.E.

Liquidations and Dissolutions.—ACCUMULATORS, LTD.—Winding up voluntarily for the purpose of reconstruction. Meeting of creditors, February 7th, at Maybury Hill, Woking. New company to be formed named Accumulators of Woking, Ltd. Liquidator, Mr. W. J. Matthews, 1, Laurence Pountney Hill, E.C.

PATENT DEVELOPMENT SYNDICATE, LTD.—Meeting called for February 27th, at Broad Street House, E.C., to hear an account of the winding-up from the liquidator, Mr. T. S. Jones.

WESTERN MAGNETO WORKS, magneto repairers, 188, Blythe Road, W. 14.—Messrs. A. H. Clarke, A. C. G. Newcombe, and H. Hills, have dissolved partnership. Debts will be attended to by Mr. Newcombe.

The Times announces that the Court has appointed MR. B. H. BINDER, F.C.A., receiver and manager of the Compania de Electricidad de la Provincia de Buenos Aires.

German Siemens Works Closed Down by Coal Shortage.—The *Economic Review* quotes from the *Köln Zeitung* a Berlin telegram of January 6th stating that, owing to coal shortage, the Siemenswerke and the Siemens-Schuckert A.-G. had stopped work until further notice.

Rand Orders for U.S.A.—The *S.A. Mining and Engineering Journal* for December 20th last stated that it understood that the two big winders—claimed to be the biggest in the world—to be installed at the Randfontein Central deep level shafts were to be supplied by the South African General Electric Co. and made in the U.S.A. The mechanical portion of the work was, however, to be placed with an English firm. Mr. Munro, the chairman of the "J.C.I." said that the new winders would be capable of raising a net load of five tons each from a depth of 5,000 ft. at 4,000 ft. per minute. The Crown Mines winders, which have hitherto held the record, can raise eight tons net some 3,500 ft. at the same speed, so that there is little to choose between them and those to be put in at Randfontein. "Randfontein will also be installing one of the biggest pumping plants in the world soon, and it is understood that the Swiss firm of Sulzer Bros. will be the suppliers. British manufacturers, apparently, are suffering through the attitude of British labour."

Civil Servants' Wages.—A Circular issued by the Ministry of Health to local authorities states that, in accordance with the award dated November 11th, 1919, the Treasury has recently authorised for permanent Civil Servants a new scale of temporary increase of remuneration owing to the abnormal conditions resulting from the war. As regards resident officers, it has been held by arbitrators that the rates of temporary increase should be one-half of the full scale; and emoluments of office of all kinds have been added to the salary received in order to determine the remuneration upon which the sum payable should be calculated. In the case of officers whose remuneration is subject to the sanction of the Ministry of Health, such sanction is given during the currency of the award now in question, and also in the event of any further award being so made.—*Manchester Guardian.*

Calendar. — From MESSRS. THERMIT, LTD., whose offices are now at 155, Church Road, Battersea, S.W. 11, and the whole of whose shares are owned by Nobel's Explosives Co., Ltd., Glagow, we have received one of their pocket memoranda books, with calendar for 1920 and Thermit information.

Lock-Out of Liverpool Electricians.—The lock-out of electricians in the Liverpool contracting industry continues, and the local Secretary of the National Federated Electrical Association has issued a statement, which makes the issues quite clear. The dispute originated with the consideration of a new code of working rules providing for a 47-hour week, 2s. per hour for a fully competent electrician, armature winder, and cable jointer, overtime at time-and-a-half for the first four hours on the first five days of the week, &c., in all, 17 amendments to the existing rules. The men's case is that the rules have been agreed with the employers locally; the constitution of the National Joint Industrial Council does not give it authority to ratify, but the Council has the right to veto any particular rule. As the National Council has merely put forth amendments, which were rejected by the men's representatives, and had not vetoed the rules, the men claimed they should be in operation, and in some shops they came out on strike. The employers, on the other hand, through the Federated Electrical Association, state that the rules were agreed with the men, and were sent as a recommendation to the National Joint Industrial Council for ratification. They were referred back to the District Joint Industrial Council for further consideration. Electrical Trades Union members then stated that they were not prepared to accept any amendments, and resigned *en bloc* from the District Joint Industrial Council, and the Union demanded the adoption of the rules, failing which, all overtime would be stopped, and if this was not effective, other and more drastic measures would be taken. The District Council had requested that any action be deferred until after the meeting of the Council of the National Federated Electrical Association in London, on the 21st inst., but, through the E.T.U. not complying, the local employers in the N.F.E.A. were in the unenviable position of having to declare a lock-out, not only in support of the four firms which were being victimised, but as a means of hastening a decision. A deputation from Liverpool put the case before the N.F.E.A. in London on the 21st inst., with the result that the Council decided to approach the executive of the Electrical Trades Union, asking if it were willing to submit the case to an arbitrator appointed by the Ministry of Labour, the Council being of opinion that the question involves other districts, and is, therefore, a national question of the greatest importance to the industry.

Staff Dinner.—The staffs of the Bury Electricity Works held their annual dinner and social last week at the Royal Hotel. Following the dinner and entertainment, Mr. S. J. Watson, borough electrical engineer, proposed the toast of the "Electricity Committee," which was responded to by the chairman, Councillor Holt.

Applications for British Trade-marks.—Appended is a summary of the recent applications for British trade-marks in respect of goods connected with the electrical industries:—

Magicoal. No 395,318. Class 18. Electric fires. Herbert H. Berry, 86, Newman Street, London, W., September 18th, 1919.

Holdtite (lettering combined with a drawing of a vice). No. 392,951. Class 50. Friction tape, being an electrical insulation material composed of fabric treated with an insulating medium. United States Rubber Export Co., 1790, Broadway, New York, July 2nd. 1919.

Thor. No. 394,198. Class 6. Electric dish-washing machines and electric vacuum cleaners. Hurley Machine Co., 2115 South 54th Avenue, Cicero, Ill., U.S.A. August 12th, 1919.

Beeco (lettering combined with design). No. 395,700. Class 13. Electrical appliances. Charles Stevens Colton, 61, St. James' Street, London, S.W., October 2nd, 1919.

While I live I'll crow (lettering combined with design). No. 396,481. Class 50. Mica insulators. Attwater & Sons, Hopwood Street Mills, Preston, October 25th, 1919.

Dyneto. No. 394,804. Class 6. Electric generators, dynamos and electric motors. Dyneto Electric Corporation, 301, Wolf Street, Syracuse, New York, U.S.A., September 3rd, 1919.

Plasphalt. No. 397,205. Class 50. Electrical insulation materials made of bitumen combined with other substances. Albert E. H. Dussek, Empress Wharf, Sherman Street, Bromley-by-Bow, E., November 13th, 1919.

Design set representing streak of lightning in black circle. No. 397,241. Class 2. Electric batteries. Siemens Bros. & Co., Ltd., Palace Place Mansions, Kensington Court, London, W., November 14th, 1919.

Trade Announcements.—Owing to increased business, the firm of H. A. Easter has built a specially-designed factory. The firm will now be known as the BRITISH ELECTRIC CO., and the address will be Easter Works, 27-29, Lower Road, Rotherhithe, S.E. 16. Telephone: "Hop 5749."

MESSRS. HAMILTON, FOULDS & Co. have removed their head offices to the works at 23, Douglas Street, Glasgow. Telephone No.: "Central 1253." They now have representatives at Manchester, Sheffield, Newcastle, Liverpool, and Cardiff, from whom particulars of their "W.H." motor starters can be obtained.

MR. J. DAWSON, late with Charlesworth & Co., has commenced business as an electrical engineer at Elliott Street, Oldham.

MESSRS. MARSHALL, SONS & CO., LTD., have removed their London offices to 3, London Wall Buildings, E.C. 2.

The style of the business of Mr. P. W. H. Challenor, iron, steel, and hardware merchant, 18, Wallbrook, E.C., has been changed to MESSRS. P. CHALLENOR & CO., Mr. A. A. Challenor having been taken into partnership.

THE ENTERPRISE MANUFACTURING CO., LTD., have been appointed sole London agents for Messrs. H. Clarke & Co., of Manchester, who are manufacturers of all classes of insulating material, nuts, bolts, washers, &c., for London and South Wales territory.

We are informed that, in consequence of the initials "E.A.C." being already used by a business house, the accumulator charging panel bearing this name will in future be known as the "Enco."

Trade Union Membership.—The membership figures of trade unions for the year 1918 have been announced. At the end of that year the 1,220 British trade unions had a membership of 6,624,000, as compared with 5,547,000 at the end of 1917, being an increase of 19 per cent. The women membership stands at, roughly, 1¼ millions.—*Daily Telegraph.*

A B.T.H. Reunion.—A company of about 50 sat down to a reunion dinner organised by the ex-Service employés of the British Thomson-Houston Co., Ltd., Coventry Branch, and held at the Craven Arms Hotel, Coventry, on Friday last. Mr. F. Betts presided, and among those present were Mr. R. Dumas (works manager), Mr. W. G. Groocock (assistant works manager), and Mr. F. W. Naylor (chief of the accountants department). After the loyal toast, the silent toast, to "Our Glorious Dead," was observed, and the names of the 12 late employés (of the Coventry Works) who had made the supreme sacrifice were read out, following which the company stood in silence for one minute. The toast, "The Company," was proposed by Mr. O. A. Pallett, who said how much the ex-Service men appreciated the kindness and consideration shown by the firm, and the way in which they had reinstated all who had returned. Mr. R. Dumas responded. In proposing the health of "The Visitors," Mr. T. Holder thanked the visitors for their presence, and the valuable work they had done at home during the war, especially mentioning Mr. Naylor, and thanking him for his zealous efforts on behalf of the soldiers. Mr. Groocock, in responding, expressed the hope that the function would be an annual occurrence. During the dinner, orchestral music was rendered, under the direction of Mr. W. G. Chapman. The remainder of the programme was contributed by Mr. D. Taylor (oboe soloist), Mr. W. Goalby (violinist), and Messrs. Breeze and Robinson sang several popular songs. The singing of "God Save the King," and a vote of thanks to the chairman and Mr. E. Thomas (who had been responsible for the evening's entertainment), brought the evening to a close.

Catalogues and Lists.—MESSRS. FULLER'S UNITED ELECTRIC WORKS, LTD., of Chadwell Heath, E., have issued a "Sparta" battery show-sheet, which has been prepared for distribution to motor garages. Copies will be sent to any applicant. The sheet illustrates the Sparta batteries and tabulates particulars of different types for popular American cars. Prices, dimensions, weights, code-words, &c., are also stated.

MESSRS. L. D. HAND & CO., 63, High Holborn, W.C. 1.—Price schedules of electrical accessories, conduits, cables, &c.

WESTERN ELECTRIC CO., LTD., North Woolwich, S.E.—Pamphlet dealing with the Western-Electric "Omniphone."

GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, E.C.—Showcard (30 in. × 20 in.) advertising the "Osram" (G.E.C.) automobile-type lamps. The card illustrates a car, with full headlights, in a dark country lane. At the bottom of the picture is a pocket designed for the reception of a very useful road-map, also supplied.

THE REMCO CARBON CO., LTD., Gravesend.—Illustrated and priced catalogue (11 pp.) of "Remco" non-metallic resistances.

THE MICANITE AND INSULATORS, LTD., Empire Works, Blackhorse Lane, Walthamstow, E. 17.—1920 List of standard insulating materials (27 pp.) and book of samples. A comprehensive list of mica, micanite, and other insulating materials for all purposes. The book of samples contains 15 selected pieces of insulation, including moulding micanite and paper, cloth and silk preparations.

MESSRS. WARD & GOLDSTONE, LTD., Sampson Works, Salford, Manchester.—Sectional List No. M 201. A complete catalogue of everything electrical for motor-cars, cycles, and garages. Fully priced and illustrated.

MR. H. C. SLINGSBY, 142-146, Old Street, E.C. 1.—List No. 155, describing and illustrating various types of mechanical trucks and labour-saving devices.

MESSRS. LESCO, LTD., Lloyd's Bank Buildings, King Street, Manchester.—Leaflets illustrating the "Lesco" lampholder and giving instructions for wiring.

THE BRITISH INSULATED AND HELSBY CABLES, LTD., Prescot, Lancs.—Pamphlet No. P.160, dealing with a "mistake proof" switch cut-out. Priced and illustrated.

Swedish Engineering Strike.—This strike is in full swing, steps intended to lead up to a settlement having proved unsuccessful.

Belgian Electricity Works During the War.—Some interesting references to the difficult position of Belgian electricity supply undertakings during the German occupation are contained in the report just issued of the Société d'Electricité du Brabant, of Brussels. In June, 1915, the German military authorities started the manufacture of barbed wire in a factory they had seized at Ruysbroeck, for the operation of which they demanded the whole of the electrical output of the Brabant Co. The directors, considering that this was a breach of international agreement with regard to war, declined to supply, with the result that the Germans not only seized the station and connected the mains up to the factory, but also imprisoned the general manager and several members of the staff. The enemy remained in possession until the Armistice, when they departed without leaving any books, cash, or account of the financial operations during the occupation. Steps are, however, being taken to put in a formal claim to the German Government. At the present time the company holds the concessions for the supply of electrical energy to 21 small towns and communes.

Auction Sales.—MESSRS. P. HUDDLESTON & CO. will sell by auction at Hammersmith on February 5th a quantity of electrical apparatus, including motors, motor-generators, fans, cable and wire, &c. MESSRS. HALL, PAIN & GOLDSMITH are instructed by the Flying Boat Co., Ltd., to sell by auction at the Norman Thompson Flight Aerodrome, Middleton, Bognor, the freehold buildings, equipment, machinery (including the electric lighting and heating plant) and stock, &c., of the Norman Thompson Flight Co., Ltd. For further particulars see our "Advertisement Pages" to-day.

Patent Restoration.—An order has been made for the restoration of Patent No. 23,082, of 1912, for "improvements in electric heating and cooking apparatus," granted to R. F. Venner.

The Protest of the Bricklayers.—Complaint was made at a meeting of the Oldham Electricity Committee last week in a letter from the secretary of the Operative Bricklayers' Society, in regard to a man in the department's employ, who was engaged in bricklaying work in connection with electric cable laying. It was contended that the man was not a bricklayer. Mr. Ogden, engineer, explained that the department promised to employ a bricklayer, and they had done so. On the day in question, however, they were particularly busy, and one of the men simply laid a brick or two. They were allowed to do that under the Whitley agreement. The Mayor thought the Bricklayers' Society ought to be reasonable. They could not stop the job while they found a bricklayer.

Trade with the West Indies.—The Federation of British Industries has accepted the invitation of important members of the West Indian commercial community to send a representative to the Special Conference of the Associated Chambers of Commerce of the British West Indies, to be held at Barbadoes on February 23rd. Mr. Moir Mackenzie, the head of the Empire Section of the Federation, has left for the West Indies in company with Sir Edward Davson. At the Conference the whole trade policy and development of the islands will come under review, especially their relations to the United Kingdom.

Book Notices.—Technologic Paper of the Bureau of Standards, No. 146. "Cadmium Electrode for Storage Battery Testing." By H. D. Holler and J. M. Braham. Washington: Bureau of Standards (free on application).—The results obtained with the cadmium electrode are often contradictory. As the result of a research described in this paper, it is stated that the electrode should be corroded several days in acid before use, and is then accurate to about 0·02 volt. The best results are obtained when the cell is discharging. The greatest error is due to polarisation, caused by using a voltmeter of low resistance; if this is unavoidable, the best procedure is to measure the cadmium-negative potential, to which the cell voltage may be added to obtain the cadmium-positive potential.

"Conquest" (a magazine of modern endeavour). Vol. I. Nos. 3 and 4. London: The Wireless Press, Ltd. Price 1s. net.—The January and February numbers of this excellent magazine contain up-to-date articles dealing with science and invention. The January issue gives notes on the Einstein theory by Chas. Davidson, F.R.A.S., and information regarding the fixation of nitrogen by the three usual processes. The later number has interesting details of Germany's commercial airships and a few corrections of Mr. H. G. Wells's scientific inaccuracies, by Mr. R. I. Pocock, F.R.S. "Conquest" is well and profusely illustrated, and its employment of non-technical language will add to its popularity.

"*Proceedings* of the American Institute of Electrical Engineers," Vol. XXXIX. No. 1. January, 1920. 28 pp. New York: The Institute.—This, the first number of a new volume, marks a change in format. The size of the publication is now 12 in. × 9 in.; it was previously 9 in. × 6 in. The increase of size permits the presentation of much fuller information, and papers are given *in extenso*. The leading papers are "The Series System of Street Lighting Distribution," and "Multiple Systems of Street Lighting Distribution."

"The English Electric Journal." January, 1920. 32 pp. London: The English Electric Co., Ltd. Price 1s. net.—This is the first number of a journal which has as its objects the recording of electrical progress, to give an account of the company's activity, and thus keep up a connection between the company and those interested in electrical development. The chief features of the Journal's initial number are a description of the Coventry Ordnance Works, and a review of the electrification of the Lancashire and Yorkshire Railway. The publication is fully illustrated and well arranged.

"Training for the Electrical Railway Business." By C. B. Fairchild, Jun. 155 pp. Philadelphia and London: J. B. Lippincott Co. Price 6s. net. The "foreword" explains the scope of this work, which is "to explain, non-technically, the business side of electric railroading, and, by defining the electric railway organisation and its varied functions, to give an insight into the requirements, the opportunities, and the training involved in the several departments of this exacting business."

"Variation in Direction of Propagation of Long Electro-Magnetic Waves." Scientific Paper No. 353 of the U.S. Bureau of Standards. 15 pp. Washington: Government Printing Office. Price 5 cents. A report on observations made by various trans-Atlantic wireless stations and methods of compensating the minimum and increasing the accuracy of direction-finder settings for long waves.

"Practical Electric Welding." By H. B. Swift. Pp. 104; 66 figs. London: E. and F. N. Spon. Price 7s. 6d. net.

"Memoirs of the College of Engineering, Kyoto Imperial University." Vol. II, Nos. 1-4. Kyoto, Japan: The University.

A French Company's Finances.—The Electrométallurgie du Zinc (procédés Cote et Pierron) is confessedly in a bad financial position, the cause being that "the patents bought from M. Cote have resulted in grave deceptions." The company has instituted legal proceedings against M. Cote.—*L'Electricien.*

Joint Industrial Councils.—The decentralisation of the Whitley Scheme of Industrial Councils, as recommended in the first report of the Reconstruction Committee, is now making substantial progress. The industries in which District Councils have been authorised or formed and the areas constituting the various districts include the following:—

Electrical Cable-Making Industry.—Home Counties (including Sussex and Hants); Northern (including Scotland).

Electrical Contracting.—Belfast, Bradford, Brighton, Derby, Dundee, Edinburgh, Glasgow, Leicester, Manchester, Mersey District, Newcastle, Sheffield, South Wales.

Electricity Supply.—Northumberland, Durham and Cleveland; the rest of Yorkshire, and parts of Derby, Notts and Lincs; Westmoreland, Cumberland, Lancashire, Cheshire and North West Derbyshire, and North Wales, South Wales and Monmouth; Staffs, Worcester, Warwick and Shropshire; Hereford, Gloucester, Somerset, Wilts and part of North Devon; Leicester, Northants, Rutland and the remainder of Notts and Derbyshire; Hunts, Cambridge, Norfolk, Suffolk and South Lincs; Bedford, Essex, Bucks, Berks, Oxford, Surrey, Kent, Herts and Middlesex (excepting parts of those counties which fall in the London area); the London area: Sussex and Hampshire; Cornwall and part of Devon; Scotland.

Tramways.—Scotland; Northern: Lancashire, Cheshire and North Wales; Yorkshire, Lincolnshire and North Derbyshire; South Wales; Midland; Metropolitan; South-Western and part of South Coast Area; East, South-East and part of South Coast Area.—*Labour Gazette.*

New French Electrical Companies.—La Dauphinoise Electrique is a new company with a multifarious programme, including the making, purchase, sale, and repair, of all kinds of electrical material, and the installation, upkeep, and working of undertakings, generating, or utilising electrical energy. Its seat is at Grenoble, and its capital 300,000 fr. With similar objects the newly formed Société d'Enterprise d'Electricité (Anciens Etablissements Champion), which is located at Paris, has a capital of 25,000 fr.

Canadian Cooking Combine.—The *Canadian Electrical News* reports that on January 1st the manufacturing departments of heating devices of the Canadian General Electric Co., Ltd., the Canadian Hotpoint Electric Heating Co., Ltd., and the Hughes Electric Heating Co., all of Toronto, were consolidated to form a new company known as the Canadian Edison Appliance Co., Ltd. This new enterprise will continue to manufacture the complete line of heating and cooking devices that have been manufactured in the past by the above-named companies.

The Ironmoulders' Strike.—The result of the ballot taken last week was as follows:—For resumption of work, 17,667; against, 11,263; majority for resumption, 6,404. The total vote was nearly 30,000, leaving 20,000 unrecorded votes. Men were returning on Monday last in most places; at Barrow there was at first disinclination, for which certain new conditions were blamed, but this point was dealt with promptly, and the men have decided to resume. General resumption is stated to mean the return of 250,000 men to employment in other branches of the engineering industry.

LIGHTING AND POWER NOTES.

Accrington.—SUPPLY FAILURE.—Owing to a failure in the supply of power on January 19th, three cotton mills had to suspend operations.

Bentley (Yorks.).—PRICE OF ENERGY.—The Urban District Council has requested the Doncaster Corporation to consider a reduction in the proposed charges for electricity, as they are too high. The Doncaster Corporation stipulated that Bentley should erect a sub-station and pay for all installation work. The method of payment for energy proposed was a charge of 1s. per week per house and 2d. per unit consumed.

Bradford.—APPEAL TO CONSUMERS.—The Electricity Department has issued a request to consumers to cut down their demands to a minimum, as the restarting of the engineering works after the moulders' strike will overload the plant considerably. A turbine undergoing repairs will be available in three weeks' time.

Cannock.—MINE ELECTRIFICATION.—In response to an urgent request from the owners of the Mid-Cannock Collieries, the Walsall Corporation is extending its mains from Bloxwich to the workings.

Chile.—WATER POWER.—In a recent issue of the *Electrical Review*, Chicago, details are given of a new hydro-electric plant being built by the Braden Copper Co. The scheme is for the utilisation of the Rio Pangal, a tributary of the Rio Cachapoal. A diversion dam is being constructed 10 miles up the river from the works, and the water will be conducted to a surge tank by a combination wood-stave and rivetted steel feeder pipe 7 miles long. The water-wheels are of the impulse type direct coupled to horizontal shaft A.C. generators. The maximum static head at present available is 1,595 ft., and the total capacity of the plant will be 20,000 K.V.A.

Continental.—BAVARIA.—Work has just been begun on a large hydro-electric generating station to utilise the water power of Lake Walchen. The lake is to serve as a regulating reservoir, and will be supplied by a tunnel connecting with a branch of the River Isaar. The exit is to consist of a partly submerged canal leading to tanks from which descend six conduits, each of 1 metre diameter. The fall is 200 metres. Energy will be distributed at 100,000 volts to a dozen or so main sub-stations, which will reduce it to 25,000 or 50,000 volts. These sub-stations will be located in the principal towns in the region, and the area supplied will extend to a distance of 280 miles from the generating station. The high-tension feeders are of aluminium with a cross-section of 120 sq. mm., and will be carried on steel poles 25 metres high above ground. When the work is completed it is expected that 80 per cent. of the total energy consumed in this region of Bavaria will be derived from water power. The station at Walchen is being constructed by the State, and the cost of distribution will be shared between the State, the principal towns, and industrial enterprises interested.—*Tramway and Railway World.*

BELGIUM.—La Société de l'Electricité du Canton de Lens is the name of a new company which has lately been formed at Lens-sur-Dendre, with a capital of 1,500,000 fr., to establish a central generating station in the Lens industrial district for lighting and power purposes.

Conway.—WATER POWER.—The surveyor reports that the power obtainable from the river is too small to be of any commercial value, and the Council is advised to obtain a supply of electricity from the North Wales Power Co.

Croydon.—HOUSE LIGHTING.—The municipal houses being constructed are to have electric lighting installed.

Coventry.—NEW POWER STATION.—The Electricity Committee has recommended the erection of a new power station and generating plant. It is said that four years will be required for the completion of this station.

Dartmoor.—HYDRO-ELECTRIC SCHEME.—According to *The Times*, in deference to the opposition from the Duchy of Cornwall and the Devon County Council, the promoters have decided to drop that part of the Hydro-Electric Bill by which they sought to utilise Dartmoor water for generating electricity. They will modify the Bill to restrict their powers to erecting overhead mains for supplying to consumers such surplus power beyond the requirements of their proposed copper-refining industry in mid-Devon, which they produce from lignite beds they intend to develop.

Dingwall.—STREET LIGHTING.—A report is being prepared with a view to the lighting of the town by means of overhead lines.

Fleetwood.—PROPOSED EXTENSIONS.—The electrical engineer having reported upon the necessity of making extensions to the electricity works before next winter, details of the proposals are to be prepared.

Greenock.—LOAN.—The Corporation is applying to the Secretary for Scotland for power to borrow £170,000 to meet the requirements of the electricity department.

Hove.—MINIMUM CHARGE.—The Town Council has reconsidered the question of a minimum charge of 13s. 4d. per quarter, and has decided instead to calculate a charge for a half-year in order to include a summer and a winter quarter.

Hull.—INADEQUATE PLANT.—The City Council has received further demands for an inquiry and report upon the electricity undertaking by an independent expert. A motion to satisfy these demands was negatived, and instead the electrical engineer has been instructed to prepare a statement for the Council's consideration. All remaining restrictions will shortly be removed, but 500 prospective consumers cannot be supplied until the plant is augmented.

Jamaica.—WATER POWER.—A scheme to utilise the water-power of one of the largest rivers for the generation of electricity, by the construction of several large reservoirs, is being prepared. The calculated cost is £120,000.

Kingston-upon-Hull.—TIME EXTENSION.—The Board of Trade has extended for six months, until July 31st, 1920, the Electric Lighting (Extension) Order, 1914, for the extension of mains, &c.

Kirkintillock.—POWER SUPPLY.—The Clyde Valley Electrical Power Co. has offered to supply power to the manufacturers of Kirkintilloch on a guaranteed minimum revenue of £5,000 per year.

Leeds.—PROPOSED EXTENSIONS.—In order to cope with increasing demands, the extension of the White Hall Road works is contemplated.

Liverpool.—ELECTRICITY IN DOCKS.—The Mersey Docks and Harbour Board is introducing electrical cargo-loading machinery, and is substituting electric light for the present gas system. It is also intended to purchase a 200-ton floating crane, to be driven electrically.

London.—HACKNEY.—The Electricity Committee recommends the expenditure of £145,930 upon additions and extensions, including £23,600 for buildings, £24,950 for plant and switchgear, and £91,375 for mains and distributors.

Melrose.—PRICE INCREASE.—The Electricity Supply Corporation, Ltd., has increased the charge for energy for lighting to 9d. per unit, as from the December meter readings.

Mexborough.—NEW STATION.—An obvious numerical slip occurred in the statement in our last issue that a new station of 10,000 KW. was to be erected. We understand that the scheme contemplates a station having an ultimate capacity of 90,000 to 120,000 KW., beginning with a 10,000-KW. set.

Milnrow (Lancs.). — BULK SUPPLY.—The District Council has been notified that Rochdale Corporation cannot undertake a bulk supply of electricity for at least 12 months. The Milnrow District Council is, therefore, communicating with Sir John Snell regarding the question.

Monaghan.—ELECTRIC LIGHTING.—A company has been formed for the purpose of supplying electricity for lighting to the town.

Richmond-on-Thames.—PRICE INCREASE.—The Electric Light and Power Co. has received permission to increase its charges to 6d. per unit for lighting, 2d. for heating, and 3½d. for power.

Rickmansworth and Chorley Wood.—TIME EXTENSION.—The Board of Trade has extended the Electric Lighting Order, 1914 (mains extension) until July 31st, 1920.

Sheffield.—EXTENSIONS.—The work to be carried out, or commenced, during 1920, includes the erection of an emergency sub-station at Blackburn Meadows and the extension of mains and installation of lighting for 1,500 new houses.

South Africa. — PORT ELIZABETH. — The Municipal Council has sanctioned an increase of 25 per cent. in light and power charges.

Swansea.—WAGES.—The Borough Council is increasing the rates of pay of its employés in the electricity department. Firemen and trimmers are to receive an additional 7s. 6d. per week. Electricians, electrical fitters, and armature winders are to be paid 1s. 11d. an hour, inclusive of awards and bonuses, and improvers 1s. 9d. per hour.

The electrical engineer has been authorised to inspect the coal-handling plant of other electrical undertakings, and instructed to make a report thereon.

Teignmouth.—COST OF SUPPLY.—Dr. Purves, holder of an order for the lighting of the town, has explained that the cost of the necessary plant would be enormous, and a cheap supply, therefore, impossible. The only hope of low-priced electricity was the development of the Dartmoor scheme.

Tunis.—HYDRO-ELECTRIC UNDERTAKING.—A new company has recently been formed in Paris, with a capital of 500,000 fr., under the title of La Société Hydraulique Tunisienne, to establish plant to utilise water power in Tunis and North Africa to generate electricity.

Worsley.—ELECTRIC LIGHTING.—The District Council has requested the Lancashire Electrical Power Co., Ltd., to tender for the substitution of electric lighting for the present (gas) system.

TRAMWAY AND RAILWAY NOTES.

Barnsley.—INQUIRY.—The Light Railway Commissioners have held an inquiry into an application by the Dearne Light Railway Board for permission to abandon an authorised route and to obtain permission to construct a line previously disapproved, and also to increase its borrowing powers. The estimated cost of the proposed route is £300,000.

Bury.—BREAKDOWN.—The tramway services were suspended for four hours on January 21st, owing to a breakdown at the Whitehead Bridge station. A switchboard attendant and two employés were slightly burned.

Continental.—FRANCE.—The Minister of Public Works announces that in future no more concessions for steam railways will be granted. It has been decided to grant permission for the construction of electric systems only.

GERMANY.—Both the district railways and the tramways in Greater Berlin have recently increased their tariffs. These increases, says the *Konfektionär* (December 31st), press very hard upon the poorer classes, for on the district railway (Hochbahn) any person travelling for five or more stations has to pay Pf.40 third-class, while the shortest possible stage in a tramcar costs as much as a journey of 10 km.—*Economic Review.*

ITALY.—The working of the Civita Vecchia-Orte railway concession is in the hands of a newly-formed company—the Società Ferroviaria Italia. The line has a length of 85·315 km.

The construction of an electric railway is contemplated connecting the Ancona-Foggia line with Osimo and Castelfidardo, and from thence to Macerata and the sea. The cost is calculated at 6,000,000 lire.

Coventry.—INCREASED LOAN.—The Corporation has applied to the Ministry of Transport to increase the amount of the loan put forward for sanction from £93,135 to £126,081. This sum is to be spent on the reconstruction of the city's tramways.

Derbyshire.—ELECTRIC RAILWAY.—A Bill has been deposited at the House of Commons to incorporate the Derwent Valley, Calver, and Bakewell Railway Co. for the purpose of constructing a seven-mile electric railway from Grindleford to Longstone.

Doncaster.—YEAR'S WORKING.—The report on the working of the tramway undertaking for 1918-19, gives the year's revenue as £53,528, and the total expenditure as £37,566, leaving a gross profit of £15,962. The net profit, after payment of interest on loans and sinking fund charges, was £8,347.

Gateshead.—TRAMWAY EXTENSIONS.—The Town Council has been advised to protest against the Bill providing for extension of the tramways across the High Level Bridge, in the absence of working agreements between the Newcastle Corporation and the Gateshead and District Tramways Co. A local inquiry into the whole of the tramway company's working arrangements, with a view to satisfying the requirements of the travelling public, is also recommended.

Glasgow.—ANNUAL VALUATION.—The annual assessment of value of the tramways by the Assessor of Railways and Canals, was £263,258, as compared with £298,165 for the previous year. The Council is appealing against this valuation, and also against the income-tax assessment amounting to £77,920.

A Special Committee has been appointed to consider the question of increased travelling facilities, and the collection of fares on the cars.

London.—ACCIDENTS.—As a result of a collision between a tramcar and a taxicab at the junction of Copenhagen Street and Caledonian Road on Friday last week, four persons were injured.

Owing to signal failure at Sloane Square station, City-bound trains on the District underground railway were delayed for 15 minutes on Thursday morning last week.

Newcastle.—STRIKE AVERTED.—Following upon promises by the Lord Mayor and the manager to secure payment for overtime worked on December 27th last, the tramway employés rescinded their strike resolution.

Surrey.—OPPOSITION TO BILLS.—The County Council is opposing the tramway Bills being promoted by the L.C.C. and the London United Tramway Co.

Tasmania.—ELECTRIC RAILWAY.—The Tasmanian Parliament has approved a survey of the route of a proposed electric railway. This will be the first in the island, extending from Hobart to the River Huron, and the question of electrifying all existing lines depends on the success of this project.

Taunton.—PROPOSED PRICE INCREASE.—The Tramway Co. declines to pay a higher price for electricity. The present rate is 1·4d. per unit, as the minimum of 120,000 units a year at 1·2d. is not taken. The matter has been referred to a special committee.

Yorkshire.—FARE INCREASE.—The tramway companies serving the "heavy woollen" district recently applied for power to increase their charges of 1½d. a mile. As this met with strong protests from the local municipal authorities, the original proposals have been modified. Authority is to be given for an extra charge of ½d. on all fares above 1½d. and upon workmen's tickets.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Delay.—Notice of telegraphic delay to Ireland, midland and south-west, is given.

France.—The Under-Secretary of State for Posts and Telegraphs announces that the additional tax of 55 centimes per franc, which has latterly been levied on the cost of all foreign telegrams, was provisionally removed on January 23rd. A plan is now under consideration to safeguard the interests of the Treasury where part of the telegraph charges have to be refunded to foreign companies in foreign currency with a consequent loss on the exchange. Some reimbursements will be necessary, as companies having accounts with the telegraph office were obliged to pay 200 fr. down to cover the extra expense when the tax was introduced only a short time ago.

Italy.—The postal, telegraph and telephone workers returned to work on January 21st, after being on strike for a week, thus preventing a Government lock-out. Their claims have not been granted, but as the Government promised before the strike, these will be put before Parliament.

Wireless Direction-Finding Stations.—The *London Gazette*, January 13th, 1920, contains an Admiralty Notice to Mariners, No. 49 of 1920, relating to wireless direction-finding (D.F.) stations. Regulations for, and particulars of, D.F. stations that have been established in Canada, Newfoundland, United States, United Kingdom, and France are given. In general the bearings taken by a station within the sector over which it is designed to work can be considered accurate to within two degrees. Bearings are often unreliable at night and in very bad weather, also when the direction runs roughly parallel with the coast line. The methods of asking for and giving bearings and the waves to be used will shortly be standardised by international agreement; and the particulars of the D.F. stations will eventually appear in the international list of wireless telegraph stations. Meanwhile, each country is publishing regulations governing the use of its own D.F. stations.

Wireless Telephony.—The Public Electricity Supply Co., of Northern Illinois, is installing wireless telephone equipment at its Blue Island and Joliet stations. The stations are 25 miles apart. The wireless telephones will have a range of about 100 miles, and will be used to safeguard communication in case the wire lines are put out of commission due to weather conditions or high-voltage induction disturbances.—*T. & T. Age.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—SYDNEY.—March 1st. Municipal Council. Supply of 2,000-K.V.A., 5,000 to 10,000-v. transformers. Electric Lighting Department, Town Hall.

MELBOURNE.—March 10th. City Council. Supply of 6,600-v. swichgear for sub-station switch houses, &c., and of six 250-K.V.A., three-phase transformers. Specifications from City Electrical Engineers' Office, Melbourne.—*Industrial Australian and Mining Standard*

April 12th. City Council. Two 2,000-KW. rotary converters; H.T. switchgear, 6,600 v.; D.C. switchgear, 600 v. (See this issue.)

ADELAIDE.—P.M.G.'s Department. Telephone material (schedules 539 and 540). (See this issue.)

Aberdeen.—January 31st. Electricity Committee. Two water-tube boilers, with superheaters, economisers, steel chimney and accessories. (January 9th.)

Aldershot.—February 17th. Urban District Council. Electricity Department. Geared turbine and generator, condensing plant, pumps, water-tube boiler and superheater, cables, &c. (January 23rd.)

Belfast.—February 14th. Tramways Committee. Tramway stores, including electrical accessories, cable, lamps, carbon brushes, trolley wire, &c. (January 23rd.)

Belgium.—February 27th. Municipal authorities of Biehen, Province of Liege. Concession for the supply of electrical energy for lighting and power purposes in the district.

March 1st. Similar concession for the municipal authorities of Glons, Province of Liege.

Colne.—Electricity Department. New or second-hand 1,250-KW. to 2,000-KW., 6,600-V. turbo-alternator, with condensing plant. (January 16th.)

Edinburgh.—February 9th. Electricity Supply Department. One overhead travelling crane. (January 16th.)

Greenock.—February 3rd. Corporation. Electrical installation work at 114 houses. Particulars from Mr. A. Nimmo, Town Clerk.

Huddersfield.—February 2nd. Electricity Committee. Six Lancashire boilers and one Green's economiser, with all fittings. Mr. J. W. Turner, Borough Electrical Engineer, Electricity Supply Works, St. Andrew's Road.

Keighley.—February 10th. Electricity Department. One 900-KW. rotary converter, complete with transformer. (See this issue.)

Kings Lynn.—February 20th. Electricity Department. One Lancashire boiler, superheater, piping, &c. (See this issue.)

London.—Metropolitan Water Board. February 2nd. Three, six or twelve months' supply of electric lamps, electric wire and accessories. Chief Engineer, South Place, Finsbury, E.C.

Salford.—February 9th. Corporation Tramways Department. Stores for 12 months. General Manager, 32, Blackfriars Street.

St. Helens.—February 7th. Electricity Committee. One steam-driven turbine feed pump. (See this issue.)

Stockton-on-Tees.—February 5th. District Fund, Gas and Electricity Committees. Articles and stores for six months. (January 23rd.)

Warrington.—February 10th. Electricity and Tramways Committee. Two water-tube boilers; two mechanical stokers (underfeed type); water softener. (January 23rd.)

CLOSED.

Belgium.—The Belgian State Railway authorities in Brussels have placed a contract with the Société des Ateliers de Constructions Electriques, of Charleroi, for a large quantity of insulated cables. For one lot of telephone cable no tenders were received.

France.—The French State Railway authorities in Paris have placed a contract with the Société des Trefileries du Havre for 30,000 metres of insulated cable; and with Messrs. Geoffrey and Delore, of Clichy, for 90,000 metres of insulated wire.

Glasgow.—Tramways Committee. Accepted :—

7/18 V.I.R. cable.—Liverpool Electric Cable Co.
½-in. vulcabeston.—Turners & Manville, Ltd.
Oil.—Vacuum Oil Co.

For Dalhousie Street sub-station :—

Rotary converter.—General Electric Co., Ltd.
Switchgear.—Metropolitan-Vickers Electrical Co., Ltd.

Electricity Committee. Recommended :—

Two 6,600-V. rotaries with spares, £37,325; four 20,000-V. ditto., £17,750.—Bruce Peebles & Co.

The Engineer reported regarding mercury-vapour rectifiers, manufactured by Brown, Boveri & Co., Ltd., and submitted an offer by that firm for the supply of rectifiers. The sub-Committee decided to recommend that the offer be submitted to the convenor, sub-convenor and the engineer, with power to accept one 500-KW. rectifier set with spares.

Government Contracts.—The following Government contracts were placed during December, 1919 :—

ADMIRALTY CONTRACT AND PURCHASE DEPARTMENT.

Electric lifts.—A. & P. Steven.
Electric platform cranes.—Stothert & Pitt, Ltd.
Low-resistance telephones.—S. G. Brown, Ltd.

MINISTRY OF MUNITIONS.

Batteries.—Tudor Accumulator Co., Ltd.
Air compressor.—Alley & McLellan.
Converters and spares.—Bruce Peebles & Co., Ltd.
Electrical plant.—English Electric Co., Ltd.

INDIA OFFICE STORES DEPARTMENT.

Cable.—Pirelli-General Cable Works, Ltd.; Siemens Bros. & Co., Ltd.; Callender's Cable & Construction Co., Ltd.
Insulator cups.—Bullers, Ltd.
Generating plant. Lancashire Dynamo Co., Ltd.
Transmitters.—Marconi's Wireless Telegraph Co., Ltd.
Electric wire.—B.I. & Helsby Cables, Ltd.
Wireless telegraph apparatus.—Marconi's Wireless Telegraph Co., Ltd.

POST OFFICE.

Protective apparatus.—Siemens Bros. & Co., Ltd.; Western Electric Co.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L.M. Ericsson Manufacturing Co., Ltd.; Karabon Co.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.
Telegraph and telephone cable.—B.I. & Helsby Cables, Ltd.; Fuller's United Electric Works, Ltd.; W. T. Glover & Co., Ltd.; Macintosh Cable Co., Ltd.; Siemens Bros. & Co., Ltd.
Distribution cases.—H. White & Co., Ltd.
Secondary cells.—Van Raden & Co., Ltd.
Joint box channels.—Ham, Baker & Co., Ltd.; McDowall, Steven & Co.
Earth clips.—E. Showell & Sons, Ltd.
Telephone cords.—Phœnix Telephone & Electric Works, Ltd.
Detectors.—Gambrell Bros., Ltd.
Ducts.—Albion Clay Co., Ltd.; Doulton & Co., Ltd.
Insulators.—Thos. de la Rue & Co., Ltd.; Doulton & Co., Ltd.
Tungsten lamps.—British Thomson-Houston Co., Ltd.; Edison & Swan Co., Ltd.; General Electric Co., Ltd.
Insulator spindles.—Bayliss, Jones & Bayliss, Ltd.
Electrophone tables.—British L.M. Ericsson Manufacturing Co., Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.; B.I. & Helsby Cables, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (incorporated with London Electric Wire Co. & Smiths, Ltd.).
Copper wire.—T. Bolton & Sons, Ltd.; B.I. & Helsby Cables, Ltd.; Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (incorporated with London Electric Wire Co. & Smiths, Ltd.); J. Wilkes, Son & Mapplebeck, Ltd.
Flame-proof wire.—H. W. Smith & Co., Ltd.
Switchboard wire.—Western Electric Co., Ltd.
Electrical equipment.—Mount Pleasant Sub-station: British Thomson-Houston Co., Ltd. Excavating and filling in trenches and constructing jointing chambers, Bridlington: Borough Engineer and Surveyor, Bridlington. Laying ducts, Queen's Park, Glasgow: R. & C. Murray. London-Manchester (Old Stratford-Loughborough, Section VI): Hardy & Co. London-Manchester (Loughborough-Derby, Section I): W. Hodge & Sons. Fraserburgh: W. Dobson. Bolton, South: W. Pollet & Co., Ltd. Gerrard-Clerkenwell Junction: D. R. Paterson, Ltd. Stratford-Walthamstow: G. J. Anderson.
Laying ducts and pipes.—Kingsland (High Street), Foote & Milne, Ltd.; Larne, Greig & Matthews; Rawtenstall (West), W. Dobson; Hawick, W. Dobson; Gerrard (N.W. of Dean Street), J. Mowlem & Co., Ltd.; Birmingham (Olton), Whittaker Ellis.
Laying ducts, troughing and pipes.—Blackheath Village, G. J. Andersen; Warwick, Whittaker Ellis; Upper Clapton-Dalston, H. Farrow.
Manufacture, supply, drawing-in and jointing cable.—Hornsey Telephone Exchange, Muswell Hill: Western Electric Co., Ltd.
Power and boiler plant.—Abu-Zabal, near Cairo, Wireless Station: English Electric Co., Ltd.
Telephone Exchange equipment.—Birmingham (North): Western Electric Co., Ltd.

CROWN AGENTS FOR THE COLONIES.

Electric light fittings for carriages.—J. Stone & Co., Ltd.
Insulators.—Taylor, Tunnicliff & Co.
Insulator spindles.—Bayliss, Jones & Bayliss, Ltd.
Telephone apparatus.—Western Electric Co., Ltd.
Copper Wire.—J. Wilkes, Son & Mapplebeck; T. Bolton & Sons, Ltd.
Insulated wire.—Hooper's Telegraph & I.R. Works Co., Ltd.

H.M. OFFICE OF WORKS.

Motor generator sets.—Electrical Construction Co., Ltd.

PUBLIC WORKS, DUBLIN.

Belfast district.—Electrical work and supplies: A. Stevenson.

Italy.—The Italian State Railway authorities have lately divided contracts for 76 electric locomotives between the following home concerns: Nicola, Romeo & Co., Saronno; the Società Italiana Westinghouse, Vada Ligue; Ernesto Breda & Co., Milan; the Tecnomasio Brown, Boveri, Milan; and the Società di Electro-Traction, Milan.

Kilmarnock.—Town Council :—

Electric lighting (dwellings).—A. G. & J. Smith & Co., £78.

FORTHCOMING EVENTS.

North of England Institute of Mining and Mechanical Engineers.—Saturday, January 31st. At the Wood Memorial Hall, Newcastle-on-Tyne. At 2 p.m. Special meeting.

Royal Institution of Great Britain.—Saturdays, January 31st and February 7th. At 3 p.m. At Albemarle Street, W. Lectures on "The Astronomical Evidence Bearing on Einstein's Theory of Gravitation," by Sir F. W. Dyson, F.R.S.

Thursday, February 5th. At 3 p.m. Lecture on "Recent Progress in Applied Optics," by Prof. A. E. Conrady.

Society of Chemical Industry.—Monday, February 2nd. At Burlington House, W. At 8 p.m. Paper on "The Theory and Practice of Lubrication: the Germ Process," by Messrs. H. M. Wells and J. E. Southcombe.

Institution of Electrical Engineers.—Informal meeting. Monday, February 2nd. At the Institute of Patent Agents, Staple Inn Buildings. At 7 p.m. Lecture on "Engineering Experiences during the War," by Major T. Bloh.

Students' meeting. Friday, February 6th. At the City and Guilds Engineering College, South Kensington. At 7 p.m. Paper on "Electric Lifts and Cranes," by Mr. F. R. Housdon.

(**Western Centre**).—Monday, February 2nd. At the South Wales Institute of Engineers, Cardiff. At 7 p.m. Paper on "Large Power Transformers," by Messrs. A. G. Ellis and J. L. Thompson.

(**Scottish Centre**).—Wednesday, February 4th. Conversazione.

Association of Engineering and Shipbuilding Draughtsmen.—Wednesday, February 4th. At the Liverpool University. At 7.30 p.m. Lecture on "Electric Traction," by Mr. W. A. Barnes.

Lectures will also be given at Manchester on February 5th; and Sheffield, on February 6th.

Batti Wallahs' Society.—Wednesday, February 4th. At the Victoria Mansions Restaurant, Victoria Street, S.W. At 6.30 p.m. Informal meeting. "Amusing Lecture," by Mr. E. S. Barralet.

Industrial League and Council.—Wednesday, February 4th. At the Central Hall, Westminster, S.W. At 7.30 p.m. Lecture on "Conditions the Workers may Control," by Major E. A. Pells.

Paisley Association of Engineers.—Wednesday, February 4th. At 25, High Street, Paisley. At 7.30 p.m. Paper on "Oil," by Mr. W. Murray.

"Daily Mail" Ideal Home Exhibition at Olympia.—Wednesday, February 4th to 24th.

Institute of Cost and Works' Accountants, Ltd.—Wednesday, February 4th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Lecture on "The Principles and Practice of Correct Costing," by Mr. A. E. Goodwin.

Royal Photographic Society, Russell Square, W.—Exhibition of prints lent by the Röntgen Society. Open till February 7th.

NOTES.

Electrical Power Engineers' Association.—At a meeting of the West Yorkshire Section, Mr. W. T. Atherton, of the National Alliance of Employers and Employed, delivered a lecture on "The Legitimate Sphere of Trade Unionism." The lecturer, who possesses great experience in the work of Trade Unions, gave it as his opinion that the bulk of the present-day Labour leaders were extremists, and, owing to the lethargy of the majority of members of Unions, were representative of only a small section. He accused the leaders of using their positions for political ends, losing sight of the real objects of Trade Unionism, which the speaker defined as securing better wages and conditions, proper treatment, constant work, and aid when work was scarce. He urged all Trade Unionists to take an active interest in the movement, and not permit themselves to be ruled by a few whose views were antagonistic to the majority. Mr. Atherton also deprecated the practice of promotion by mere favouritism, instead of by merit, and considered that this came within the scope of Trade Unions, which should insist upon the preferment of men whose ability entitled them to it. He characterised striking as the last resource of men who could not secure justice by peaceable means. If direct action was insisted upon to the detriment of public interests, the speaker thought that the public, including many Trade Unionists, would act as strike-breakers, and quite rightly so. As an instance of the way in which ill-informed workers obtained an exaggerated idea of the strength of the Union funds—an idea which worked incalculable harm—Mr. Atherton quoted the recent moulders' strike. Mr. Dyson (Hull) asked if the extremists might not defend their attitude by saying that they were simply departing from old-fashioned methods to adopt newer and quicker means of obtaining the same ends. Mr. Atherton did not consider that the extremists' methods were quicker, especially if they involved Parliamentary procedure, and they were certainly the least desirable. Mr. Jones (Dewsbury) said that under the existing methods of Trade Unionism the conscientious worker was bound to receive the same wage as an inferior man. Mr. Atherton attributed this condition of affairs to the lack of live interest in the mass of Trade Unionists, who should prevent their leaders from getting away from their real duties. The chairman (Mr. Chaytor) said that the E.P.E.A. was held in distrust by both employers and the Trade Unions, and urged that it should be represented on the National Electrical Industrial Council. He thought that the Association would have a moderating effect upon both sides.

An Electric Baling Press.—Where power is available, electric baling presses present many good points, amongst which are rapidity of operation and low cost of maintenance. A press of this class, which is illustrated in *Engineering*, was designed and built for the South Indian Export Co., Bombay, by Messrs. Hindle, Son & Co., of Haslingden, Lancs. The press exerts a total nominal pressure of 200 tons, and is worked by a series-wound motor, capable of a peak output of 30 B.H.P. at 230 R.P.M., and accelerating on light loads when lowering to 1,200 R.P.M. The frame does not take the stress exerted, as in the hydraulic press, but merely supports the table, machinery, &c. The whole of the machinery, motor, gearing, winding drums and brake are arranged on a casing on the top of the press framework. The table is raised by specially flexible steel cables, the load being distributed between 40 ropes. The rope from each corner is led up and wound on two grooved parallel winding drums, driven by the motor by worm and spur gearing. The motor runs in one direction for raising, and is reversed for lowering the press table; the pressure exerted can be maintained for an indefinite period by means of an electro-magnetic disk brake on the motor shaft. The control is by push-buttons which operate contactor switches; the press table operates an auxiliary switch at the top and bottom limits of its travel to prevent overwinding. A trip switch, incorporated in the controller, acts on a predetermined current being reached, and stops the motor when full pressure is obtained.

Dublin Electricity Official Imprisoned.—Mr. Fred. J. Allan, secretary of the Dublin Corporation Electricity Supply Committee, was convicted at the Dublin Northern Police Court, on Friday last, under D.O.R.A. Regulations, of having had in his possession, or under his control, at the Sinn Fein South Dublin municipal election committee rooms at Kingstown, leaflets relating to the recent election, which were suppressed as being likely to cause disaffection. Mr. Allan declined to enter into bail to provide sureties that he would keep the peace for two years, and was, in default, sent to jail for three months.

Electrolytic Potassium Permanganate.—Mr. M. deKay Thompson, in an article in *Chemical and Metallurgical Engineering* of November 29th to December 3rd, 1919, shows that experiments have proved it to be possible to manufacture potassium permanganate from commercial ferromanganese, containing about 75 per cent. manganese, by electrolysis in a potassium carbonate solution without the necessity of ever cleaning the anodes. The temperature must not be allowed to rise much above 40 deg. C., for if it does an insulating coating of oxides is formed, which prevents the production of permanganate. Carbonic acid is not lost in the electrolysis. The current efficiency was about 17 per cent., but it would be higher with better diaphragms. The current density was 65 amp. per sq. ft. The anodes are attacked more at the top than at the bottom. The anodic behaviour, as regards formation of insulating scale, is affected by a small change in the relative amounts of iron and manganese in the anode.

Wages in Electricity Supply Undertakings.—The Board of Trade *Labour Gazette* states that the District Council established, under the Whitley Scheme, for the electricity supply industry in the North-Western area of England and Wales (Cumberland, Westmorland, Lancashire, Cheshire, Anglesey, Carnarvon, Denbigh, Flint, Merioneth, Montgomery, and part of Derbyshire) has now fixed rates for Lancashire and Cheshire. In these counties the Council has determined that there shall be three separate "Zones," in which differential rates shall be paid. "Zone A," for which the highest rates are fixed, comprises Liverpool (Corporation undertaking), Bootle, Birkenhead, Manchester, Oldham, Salford and Stockport; "Zone B," for which lower rates are fixed, includes Blackburn, Blackpool, Bolton, Bury, Chester, Preston, Warrington, Wigan, and a number of other places; and "Zone C," in which the rates are lowest, includes the undertakings in such districts as Alderley and Wilmslow, Altringham, Cark, Crewe, Hoylake and West Kirby, Macclesfield, Morecambe, Northwich, Ormskirk and Prescot. Comprehensive schedules have been drawn up for each of these "Zones," specifying the rates of wages fixed for the various grades of workpeople, and have been approved by the National Joint Industrial Council for the Electricity Supply Industry. In the following table a few examples are given of the basic rates fixed for Lancashire and Cheshire. The new rates are payable as from September 4th last. The hourly rates shown are calculated on the basis of the weekly hours in operation before the reduction in hours which took place in 1919. Accordingly, to obtain the weekly "basic" rates these hourly rates must be multiplied by the hours formerly worked (usually 53 for day-workers) and not by 47, the present working hours. In addition to these basic rates, war wage advances are payable, amounting to 33s. 6d. per week in the case of men of 18 years or over. A bonus of 12½ per cent. on earnings is also paid to men 21 years of age or over.

Grade.	Basic rates of wages fixed per hour for undertakings in Zone A.	Zone B.	Zone C.
Electrical fitters	Standard district engineering rate.		
Electricians or elec. wiremen			
Armature winders			
Jointers	9·5d.	9d.	8·5d.
Plumber jointers	10·5d.	10d.	9·5d.
Meter fixers	7·65d.	7·25d.	7d.
Cable hands	6·75d.	6·25d.	6d.
Fitters' mates	6·75d.	5·75d.	5·5d.
Electricians' mates	6·75d.	5·75d.	5·5d.
Labourers, general, indoor ...	6·3d.	5·75d.	5·5d.
" " outdoor ...	6·75d.	6·25d.	6d.
Switchboard attendants :—	Per week.	Per week.	Per week.
Plant up to 5,000 KW. ...	45s.	37s. 6d.	32s. 6d.
" above 5,000 KW. ...	54s.	42s. 6d.	37s. 6d.

The Council was elected in August, 1919, by representatives of all electricity supply undertakings in the North-Western Area, and by the Trade Unions concerned. It consists of 12 employers' representatives and 12 Trade Union representatives. Alderman T. E. Higham, J.P., C.C. (Accrington), is chairman of the Council, and Mr. P. A. Irvine, of the Electrical Trades Union, vice-chairman.

An Ex-Service Men's Association.—The "Ex-Service Professional and Commercial Association" has been formed to protect and promote the interests of the many men who, engaged in a profession or trading on their own account, sacrificed all in order to answer their country's call, and have consequently suffered serious losses—in some cases total destruction of their businesses. The Association will issue to its members a badge ("the sign of the Tin Hat"), which will enable the public to identify a shop or office the owner of which "did his bit"; no further inducement should be necessary to persuade the public to give preference to such cases. A buyers' guide and directory will be prepared, giving the names and addresses of members, and an inquiry bureau will be opened. Women with suitable qualifications will be entitled to full membership. The annual subscription is 5s.; honorary members (not in business on their own account) may join with a minimum subscription of 2s. 6d. per annum. Service in the Navy, Army, or Air Force between August, 1914, and November 11th, 1918, is the necessary qualification. The head offices are at 38-39, Piccadilly, London, W.

London County Council and Electricity Supply Loans.—The Finance Committee of the London County Council reports as follows:—

"By Section 19 of the Electricity (Supply) Act, 1919, the Council ceases to be the sanctioning authority for borrowing by Metropolitan Borough Councils under the Electric Lighting Acts and Orders, and the duty of sanctioning them is transferred to the Electricity Commissioners, who, however, are required to act in consultation with the Council in regard to the powers thus transferred. Pending the appointment of the Electricity Commissioners, there is no appointed authority for the sanctioning of these loans, unless it be held that the Council should continue to sanction the loans until the Commissioners are appointed. This is the view taken by the Board of Trade, and we propose to act upon it. We are taking steps to ascertain as soon as practicable what advice the Electricity Commissioners will desire to have from the Council, and to what extent they wish the Council to examine applications for the loans in question."

State Control of London Transport.—The Ministry of Transport has been requested to take over the control of the whole of the undertakings of the London Traffic Combine. The latter states that at the present rate its deficit for the year would be £2,600,000. It was stated that the Ministry was considering the question of control of the Underground railways under the Transport Act, but would not take over the motor-omnibuses. As the latter are the principal source of loss, and have been considered part of the Combine's scheme, the loss being considered in relation with the revenue from the railways, the Combine considers that the omnibuses should also be placed under State control. If they were run as a separate concern fares would necessarily have to be increased, and this would divert traffic to the underground railways, making the position worse than ever. The question of guaranteeing shareholders their pre-war income, as has been done in previous instances, requires carefully looking into, as many of the separate undertakings of the Combine were working at a loss prior to the war.

Canadian Power Company's Law Case Settled.—A Reuter dispatch from Ottawa states that the claim for a million dollars made by the Toronto Power Co. against the Dominion Government has been settled out of Court for $800,000, of which the Ontario Power Co. is to pay $510,000 and the Dominion Government the balance. The question at issue arose out of the distribution of power in the Niagara district by the Power Controller during the war.

Post Office Robberies.—In a letter to *The Times*, Mr. R. Gladstone suggests that a very simple and effective way of preventing robberies at post offices and banks would be to fix a large electric alarm gong high up on the wall outside each post office, controlled by switches just under the counter.

Educational.—Engineering scholarships for local apprentices, tenable at the Manchester Municipal College of Technology, or some other suitable institution, are to be founded in Manchester as a result of the generosity of the contractors to the Manchester and District Armaments Output Committee. Further information can be obtained from Mr. H. J. Brocklehurst, M. Eng., The College of Technology, Manchester.

The Coal Rebate.—Consumers of electricity will receive their rebates on account of the reduction in the price of coal at the end of the March quarter; there will be no separate rebate for December.

Electric Furnaces.—Referring to the notice in our issue of January 9th, as to the supply of electric furnaces to Norway, our Bradford correspondent writes that Messrs. Jessop & Boydell, electrical contractors, of Bradford, are supplying and shipping to Tyssedal, Norway, five 800-K.V.A. single-phase furnaces, to be used for the manufacture of pig-iron from Norwegian ore concentrates without briquetting.

Automatic Lighting Sets.—In the course of his speech at the special meeting of the Austin Motor Co., Ltd., at Northfield, at which resolutions were passed increasing the capital by 3,350,000 shares of £1 each, to £5,000,000, Sir Herbert Austin said that the company's schedule of production, necessitated by the orders already in hand, called for a weekly output of 200 20-H.P. cars, 100 agricultural tractors, 60 30-cwt. lorries, 500 electric lighting sets, and a large amount of switchboards and other electric equipment. He said that they had recently completed the tests, and passed into mass production, of a complete automatic lighting outfit, which would give current sufficient for a small country residence, and which they were selling at an inclusive price of about £120. The possibilities of the sale of this type of outfit he described as enormous. Although they were preparing a large production, they would not be able, unless they made very large increases to their schedule, to do more than touch the fringe of the possibilities of this part of their programme. They had three or four other sizes of automatic lighting sets of larger dimensions scheduled for production, which would enable them to accept orders for outfits up to those required for village and small township lighting.

Fatalities.—The White Lund Munition Works explosion caused the death of two electricians and seven others, on January 14th. The former, Jos. Augustine Thompson (23), and Stanley Bridson (18), were busy repairing lights when they met their death, but Mr. Harry B. Kershaw, charge electrician, made it clear to the Coroner on Monday last that there was no fault in the installation that would have caused a spark. The distribution board was outside the room. The fuses were drawn out of the circuit they were working on. The single-pole switch was knocked off, which precluded the idea of a wire fusing. A verdict of "Accidental death" was returned.

At the inquest on George Corser (55), a Heywood gardener, who succumbed to injuries received as the result of an explosion in Bury, a verdict of "Accidental death" was returned. It was stated that a number of men were disconnecting the electric cables in consequence of a leakage, when the explosion occurred, and Mr. S. J. Watson, the borough electrical engineer, attributed the explosion to the presence of gas.

Signals from Mars?—A journalistic sensation this week was based on a statement of Senator Marconi that signals frequently received on a long wave-length from an unknown but very distant source might possibly emanate from Mars or some other planet. In the *Daily News* of Wednesday, Mr. Marconi protested, with some indignation, against the interpretation that had been placed upon his "purely fanciful speculations."

R.E. Dinner.—A dinner for ex-members of the 351st E. and M. Co. R.E. is being held in London on February 14th. Those members who have not yet been communicated with should write at once to the hon. secretary, Lieut. H. F. A. Kinder, 9, Maze Hill, St. Leonard's-on-Sea.

The Tunnelling of Mont Blanc.—A Reuter message to *The Times* states that French and Italian engineers have arrived in Chamonix in order to study the ground and make all necessary investigations for the boring of a tunnel under Mont Blanc, through which a line would be run linking up France and Italy. The project has been under examination for many years, but at last appears to be near execution, as both the French and Italian Governments have voted the necessary credits for the construction of the tunnel, France allotting 45,000,000 fr. to the work, and Italy 40,000,000 lire.

The "Lay" Press.—In *Electrical Industries* there appears a letter (signed "Supply") defending *The Times Trade Supplement* against our recent criticism, but endorsing our advice to supply authorities to hurry up with their co-operative schemes. From the references to "our contemporary" in the letter, it would appear that it was submitted for use as a leaderette, but the editor preferred to put it under the head of "Correspondence." We should not be surprised to learn that "Supply" wrote the article in the *Supplement*. A leading article in the same issue of *Electrical Industries* attacks *The Times* with virulence, referring to it as "our amazing contemporary," and characterising its views on the moulders' strike as "the nonsense of ignorance."

Promotion in the Navy.—At the instance of the Admiralty, says the *Morning Post*, it is provided by an Order in Council that commissioned electricians are to be eligible for promotion to the relative rank of lieutenant with the title of electrical lieutenant, and, on attaining eight years' seniority as such, are to have the relative rank of lieutenant-commander.

Inquiries.—Makers of the F. T. Reed patent time switch; of a lamp suitable for installation inside a baker's oven; of McDougall's patent commutator grinding blocks; and of electric floor polishers, are asked for.

Appointments Vacant.—Cable jointer (84/1) for the Tynemouth Corporation Electricity Works; plumber jointer for the Wolverhampton Electrical Engineers Department; shift engineer (82/7) for the Eccles Corporation Electricity Works; correspondence clerk (£200) for the Walthamstow Urban District Council Electricity Department; sub-station attendant (82/8) for the Stoke Newington Borough Council Electricity Works; shift engineer (£220) for the Torquay Corporation Electricity Department. See "Official Notices" to-day.

Synthetic Ammonia.—A new French process for the production of synthetic ammonia, invented by M. Georges Claude, and superior to the Haber process, is to be put in operation at Maryport by the Cumberland Coal, Power and Chemicals, Ltd. It is claimed that the scheme will provide the whole of the nitric acid, nitrate of ammonia, cyanides, &c., required by this country at a lower price than from Chile nitrate.

Protection for X-ray Workers.—The December *Archives d'Electricité Médicale et de Physiothérapie*, in an article commenting upon the death of Dr. Jaugeas, the Parisian X-ray surgeon, puts forward several suggestions for the protection of those engaged in X-ray work. Isolated platforms are recommended, as well as rubber gloves and shoes. All parts of the apparatus should be electrically continuous and efficiently earthed. When the right hand is touching a wire the left should be placed behind the back. Many other precautions and safeguards are given by various authorities on the subject.

INSTITUTION NOTES.

Institution of Electrical Engineers.—A debate between representative members of the Midland Junior Gas Association and the SOUTH MIDLAND CENTRE of the I.E.E. will take place at the Birmingham Council House, on February 5th, on the subject of "The Uses of Gas and Electricity." The debate will be opened by Dr. E. W. Smith, chief chemist at the Birmingham gas department, on the Utilisation of Fuel for the Generation of Power; and the case for electricity will be submitted by Mr. F. Forest, M.I.E.E. Dr. C. W. Walter, of the Industrial Research Laboratory of the Birmingham gas department, will speak on "The Industrial Application of Gas and Electricity" (furnaces in particular), and Mr. E. J. Moffatt, B.A., will present the claims of electricity. Other subjects to be discussed in the debate will include Domestic Appliances, Transmission or Distribution of Power, and the discussion will be wound up by Dr. Smith and Dr. C. C. Garrard, M.I.E.E. Councillor Marks (Electricity Supply Committee, Birmingham) will preside.

SCOTTISH CENTRE.—A paper, entitled "The Electrical Power Supply in the War Zone," was read by Major Thos. Rich, O.B.E., at Edinburgh, on January 13th. The chairman, in thanking the author, characterised the paper as full of first-hand information and absorbing details.

Institution of Civil Engineers.—The Council proposes to take steps for the introduction of the measure for the registration of civil engineers in the next Session of Parliament as a Public Bill. The proposal is that any person who complies with the qualifications to be laid down by the Institution shall have a right to be registered, whether a member of the Institution or not, and eligibility to register does not involve any obligation to become a member of the Institution of Civil Engineers or of any other society. The Council claims that the body which is best fitted to determine the proper qualifications and to regulate the conduct of those registered is the Institution of Civil Engineers.

Paisley Association of Electrical Engineers.—On January 16th, a lecture on "Electricity and Matter" was delivered by Principal Angus M'Lean, B.Sc., and on the 17th the members visited the works of The Howden Boiler and Armaments Co., Ltd., at Govan. The chief items of interest were turbines and high-speed engines in various stages of construction.

Greenock Philosophical Society.—Under the auspices of this Society, Prof. C. G. Barkla, F.R.S., of Edinburgh University, delivered the Watt anniversary lecture in the Watt Institution, on January 16th, the subject being "Radiation and Matter"; the lecture was illustrated by experiments and lantern slides. His own investigations had been concerned with the electrons, not at the surface, but deep within the atom. The outer electrons were those which determined the optical and chemical properties of a substance; the inner ones were those which vibrated so rapidly as to emit, not light, but X-rays and gamma rays. He had found that each element under suitable stimulus emitted its own characteristic X-rays; that was, it had its own characteristic "colour" in X-rays, which chemical and physical processes could not affect. There were, in fact, series of X-ray spectral lines. Recent investigations had afforded strong evidence of a high-frequency X-radiation, which was possibly due to vibrations in the nucleus itself. This was at present being studied in the Edinburgh University physics laboratory.

Society of Dyers and Colourists.—A lecture was delivered before the members of the West Riding Section of the Society on January 22nd, by Dr. F. M. Perkin, in which he surveyed the increasing application of electricity in the dyeing industry. After stating the advantages to be derived from the use of electricity, he showed how, generally, caustic soda, chlorine, and other dyework materials were now being produced electrically, and the degree of purity of the bleaching agents, solvents, and scouring materials so produced. Dr. Perkin, asked by one of the members, if he thought the results obtained by electrochemical methods would justify further expenditure in this direction, replied that he did not think Government schemes would prove of much advantage, but the work of installing power plant at the pitheads would be done by private enterprise. Cheap electrical power would be accomplished by private enterprise, and then that power would be available for electrochemical processes as well as for power.

Association of Mining Electrical Engineers.—At a meeting of the Midland Branch of the Association, at Nottingham University College, on January 17th, Mr. A. W. Williams, of Mansfield, condemned the vagueness which characterised certain regulations in connection with the use of electricity in mines. Indefiniteness as to the safeguards to be adopted had, he thought, led to the creation of a complicated position in certain cases. He urged that all apparatus should not only be made to conform to certain specifications, but should also before being used in mines, be certified, and a certificate should be secured by the manufacturers from a Government department. This reasonable request would cover the manufacturers and relieve the electrical engineer of the responsibility as to whether the apparatus was suitable or not. At the same time it would obviously not necessarily relieve the electrician of the responsibility as to the type of system or apparatus to be adopted. The granting of a certificate by the Home Office indicating, after official inspection, that the apparatus had been approved, would have a tendency in the direction of giving confidence to all concerned. It might be urged that these tests would involve a number of inspectors, but the result would be increased safety in operation, and if the inspectors were competent and had a knowledge of electricity as applied to underground workings, the additional expenditure would be well justified. A resolution was passed with the object of calling the attention of the Home Office to the vagueness of certain of the existing regulations, and suggesting the need of revision.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Shareholders of the Metropolitan Wagon & Finance Co. last week presented Mr. F. DUDLEY DOCKER, C.B., with an illuminated address in appreciation of his administration of the affairs of the company during 17 years. The address was accompanied by a sum of money for the creation of Docker scholarships at Birmingham University. A presentation was also made to Mrs. Docker.

Mr. E. H. W. COOKE, chief accountant to the Birmingham Gas Department, has been appointed chief accountant to the Metropolitan-Vickers Electrical Co., Trafford Park. He has been in the employ of the Birmingham Corporation 30 years. He was engaged in London on the compilation of the register of volunteers, under National Service, and later became chief registration officer to the Birmingham Food Control Committee.

The Newcastle-under-Lyme Corporation has increased the salary of the borough electrical engineer, Mr. A. J. C. DE RENZI, to £450 per annum.

The *Times* states that Mr. L. H. KIEK, general manager of the Anglo-South American Bank, has been elected a member of the board of the Vera Cruz Electric Light, Power, and Traction, Ltd.

Mr. E. MERCER has resigned his position as resident engineer under the Yorkshire West-Riding Tramway Co., Castleford, and has started in business as the Electrical Contracting and Motor Co., Castleford. He wishes to receive lists and catalogues of electrical goods.

The Electrical Contractors' Association of Scotland (Glasgow Branch) held a successful "At Home" in the Burlington House, when a presentation of silver salver and purse and cheque was made to Mr. J. M. DAVIES on retiring from the secretaryship of the Association, and a pendant to Mrs. Davies.

The Burton-on-Trent Town Council has increased the salary of the electrical engineer (Mr. HALL) by £150 a year.

The Military Cross awarded to Capt. F. L. LAWRENCE, R.F.A., works manager of Chamberlain & Hookham, Ltd., for distinguished service on November 6th and 7th, 1918, while in action near Mons, was presented to him at the recent local investiture held by H.R.H. Prince Henry at the Birmingham Town Hall.

At Cape Town in December the employés of Messrs. E. A. Shaw & Co., were entertained to a smoking concert by Mr. F. E. TRILL, who was severing his partnership connection with the firm. Mr. Hylands, the works manager, on behalf of the employés, presented Mr. Trill with an illuminated address and a silver rose bowl.

The employés of the Musselburgh & District Electric Light and Traction Co., Ltd., held their annual dinner, the first since the war, on the 15th inst. The local director, Mr. J. ANDERSON, took the chair. Several of the employés contributed to the musical programme. During the evening the manager, Mr. H. C. Babb, presented the oldest employé, Mr. W. Elliot, who has been with the company since its inauguration, with an envelope of Treasury notes.

Obituary.—DR. CECIL R. C. LYSTER.—We regret to learn that Dr. Cecil R. C. Lyster, who was for 17 years in charge of the electro-therapeutic department of the Middlesex Hospital, passed away on Monday at the age of 60 years. He is described as a "martyr to science." The *Times* states that he was a pioneer in X-ray investigation, particularly in relation to the treatment of cancer. "Through exposure to the rays in the early days of research, he himself contracted the disease, but in spite of much suffering he insisted upon pursuing his invaluable work until a few weeks ago, when he was compelled to lay it aside." It appears that recently he had been concerned in an attempt to standardise the application of radium as a remedial agent in the treatment of cancer, and though a victim to the disease he had sought to conquer he declined to be set aside from his purpose.

MR. K. L. AITKEN.—The *Electrical News* (Canada) reports the death of Mr. Kenneth L. Aitken in California. Mr. Aitken was manager of the Toronto hydro-electric system in its early days.

MR. J. H. P. BROWN.—The death has occurred, at the age of 57 years, of Mr. J. H. P. Brown, who until a few months ago was P.O. telegraph superintendent at Hull. He had been in the service 44 years.

NEW COMPANIES REGISTERED.

General Welding Co., Ltd. (10,881).—Private company. Registered in Edinburgh January 9th. Capital, £10,000 in £1 shares. To carry on in Glasgow the business of welders by oxy-acetylene and other autogenous processes, &c. The subscribers (each with one share) are: R. Baillie, 11, Woodhall Drive, Cardonald, Glasgow, engineer; A. Paton, 145, Old Shettleston Road, Glasgow, boilermaker; P. Linn, 318, Scotland Street, Glasgow, secretary. The first directors are: R. Baillie, A. Paton and P. Linn. Qualification, £100. Registered office: 19, Muirhouse Street, Glasgow.

Iceni Engineering Co., Ltd. (163,037).—Private company. Registered January 20th. Capital, £3,000 in £1 shares. To carry on in Letchworth and elsewhere the business of mechanical and electrical engineers, &c., and to adopt an agreement with T. F. Wild. The subscribers (each with one share) are: J. W. E. Powell, 204, Broadway Chambers, Letchworth; G. W. Swanson, 7, Norton Way North, Letchworth; C. F. Ball, 336, Norton Way, Letchworth. The first directors are: C. F. Ball, J. W. E. Powell, G. C. Swanson, E. J. Simmons and C. H. Jolley. Solicitor: F. W. G. Bolton, Letchworth.

Portadown Electric Co., Ltd. (4,871).—Private company. Registered in Dublin January 8th. Capital, £20,000 in £1 shares (5,000 preference). To produce, store, supply and sell electrical energy, &c. The subscribers (each with one ordinary share) are: M. Curran, 2, Kent Street, Belfast, electrical engineer; D. Chapman, Edenderry, Portadown, jam merchant and druggist. The first directors are: M. Curran and D. Chapman. Registered office: 7-9, Market Street, Portadown, Co. Armagh.

Tuam Electricity Co., Ltd. (4,808).—Registered in Dublin on September 14th. Capital, £8,000 in £1 shares. To carry on in Tuam and elsewhere the business of an electric light company. The first directors are: A. Eaton, St. Jarlath's College, Tuam; O. Harman, Tuam; G. Murray, Tuam; A. O'Malley, Tuam; T. J. Mellin, Tuam; and P. McTigue, Tuam. Secretary: J. Daly. Registered office: Dutlin Road, Tuam.

Technical Intelligence Service, Ltd. (162,972).—Private company. Registered January 17th. Capital, £1,000 in £1 shares. To carry on the business of a news and intelligence agency, &c. The first directors are: E. Hudson, 15, Queen Anne's Gate, S.W., newspaper proprietor; Major W. E. Simnett, Temple Fortune House, Hampstead Way, N.W.4; H. Pratt, 62, Lyford Road, S.W.18, newspaper director. Registered office: 20, Tavistock Street, Covent Garden, W.C.

Technical Review, Ltd. (162,973).—Private company. Registered January 17th. Capital, £2,500 in £1 shares. To carry on the business of proprietors and publishers of newspapers, reviews and periodicals, &c. First directors: E. Hudson, 15, Queen Anne's Gate, S.W., newspaper proprietor; Major W. E. Simnett, Temple Fortune House, Hampstead Way, N.W.4; H. Pratt, 62, Lyford Road, S.W.18, newspaper director. Registered office: 20, Tavistock Street, Covent Garden, W.C.

I. Calvete, Ltd. (163,036).—Private company. Registered January 20th. Capital, £10,000 in £1 shares. To take over the interest and goodwill of I. Calvete and L. N. Viola in the business of contractors, electrical and mechanical engineers, manufacturers of electrical apparatus, &c., carried on by them at 11, Little Street, Andrew Street, St. Martin's Lane, W.C. The first directors are: L. N Viola, 6, Russell Court Mansions, Great Russell Street, W.C.; I. Calvete, 17, Upper Addison Gardens, West Kensington, W Solicitor: L. E. Townroe, 26, Budge Row, E.C. Registered office: 11, Little St. Andrew Street, St. Martin's Lane, E.C.

Southwark Lighting Co., Ltd. (163,008).—Private company. Registered January 19th. Capital, £1,000 in £1 shares. To carry on the business of manufacturers, importers and exporters of and dealers in electrical, gas and lighting goods and accessories, &c. The subscribers (each with one share) are: W. Lennard, 3, Love Lane, Eastcheap, E.C., produce merchant; R. C. Radeglia, 3, Love Lane, Eastcheap, E.C., merchant. The first directors are: W. Lennard (chairman) and R. C. Radeglia. Solicitor: H. Crafter, 7, Southampton Street, W.C. Registered office: 3, Love Lane, Eastcheap, E.C.

Power Research Co., Ltd. (163,004).—Private company. Registered January 19th. Capital, £100,000 in £1 shares. To acquire and turn to account any mines, rights and property in the U.K. or elsewhere, and to carry on the business indicated by the title. The subscribers (each with one share) are: P. G. Smart, 38, Salisbury Road, Forest Gate, E.7, clerk; B. R. Bayliss, 21a, Parkholme Road, Dalston, E.8, clerk. The subscribers are to appoint the first directors. Solicitor: G. C. Pullman, 24, Coleman Street, E.C.

Portumna Electric Light and Power Co., Ltd. (4,874).—Registered in Dublin on January 12th. Capital, £5,000 in £1 shares. To carry on in Portumna and elsewhere the business of an electric light company. The directors are: Viscount Lascelles, A. E. Moeran, Mrs. M. M. Nolan, J. Hynes, N. J. Kelly, J. Corcoran, G. J. Coates, J. Taylor, and J. Murphy, all of Portumna, County Galway. Secretary: M. C. Woulfe. Solicitor: J. J. Kearns, Portumna, Co. Galway. Registered office: New Street, Portumna, Co. Galway.

Car Lighting Set Co., Ltd. (162,890).—Private company. Registered January 16th. Capital, £5,000 in £1 shares. To carry on the business of manufacturers, suppliers, installers and repairers of lighting, heating, starting and driving apparatus and appliances for all kinds of cars, vehicles and boats by electricity, fuel, gas, spirit, oil, &c. The subscribers (each with 500 shares) are: C. W. Akers, 224, Brixton Hill, S.W.2, scientific instrument maker; A. J. Austin, 308, Brixton Hill, S.W.2, engineer; W. Blenkarn, 30, Gleneagle Road, Streatham, S.W.16, electrical engineer. The first directors are: C. W. Akers, A. J. Austin and W. Blenkarn (all permanent). Registered office: 36, Maiden Lane, Strand, W.C.2.

British Electrical Development Association (162,942).—Registered January 17th as a company limited by guarantee, not formed for profit The word "limited" being omitted from title by licence of the Board of Trade. Objects: To promote and protect electrical industry and enterprise in the British Empire, to develop the use of and demand for electrical energy for industrial, commercial, public, domestic, agricultural and other purposes, &c. There are to be founders, ordinary members and associates. The first members of the Council are: S. T. Allen, Homelea, Wrottesley Road, Tettenhall, Staffs; L. B. Atkinson, Alste, Little Hampden, Great Missenden; C. O. Bastian, 32, The Avenue, N.W.6; C. R. Belling, 10, Glebe Avenue, Enfield; A. F. Berry, Hayes, Middlesex; T. H. Bowden, 101, Eltham Road, Lee, S.E.12; W. A. Chamen, The Gables, Llantwit Pardre, Pontypridd; J. Christie, A. C. Cramb, R. S. Downe, D. Watson, D. N. Dunlop, I. E. Edgecombe, I. W. Elliot, S. E. Fedden, W. A. Gillott, E. E. Hoadley, E. T. R. Murray, H. C. Palmer, A. R. Phipps, F. I. Walker, F. H. Williams, W. B. Woodhouse and C. H. Wordingham. Each founder (including the Institution of Electrical Engineers, the British Electrical and Allied Manufacturers' Association, the Incorporated Municipal Electrical Association, the Incorporated Association of Electric Power Companies, the Electrical Contractors' Association, Incorporated, and the Electric Lamp Manufacturers' Association of Great Britain, Ltd.) is to be entitled to one representative on the Council. Solicitor: T. Trimmell, 71, Lincoln's Inn Fields, W.C.

Simplex Power Generator Co., Ltd. (163,053).—Private company. Registered January 20th. Capital, £2,000 in £1 shares. To acquire and turn to account any invention relating to power, gas and gas engines, &c. The first directors are: Capt. E. F. Hill, Southmead, Newbury, Berks; R. G. Harley, 20, Market Street, Mayfair, W., accountant. Solicitor: R. Burrow, Rolls Chambers, 88-9, Chancery Lane, W.C. Registered office: 20, Market Street, Curzon Street, Mayfair, W.

London Electricity Joint Committee, 1920, Ltd. (163,101).—Private. Registered January 21st. Capital, £50,000 in £1 shares. To prepare schemes with a view to the improvements of the organisation of the supply of electricity within the counties of London and Middlesex and adjoining counties or districts. The subscribers (each with one share) are: W. F. Fladgate, 18-19, Pall Mall, S.W., chairman, Charing Cross, West End and City Electricity Supply Co., Ltd.; Lord Downham, Eccleston Place, Belgravia, S.W., chairman, Westminster Electric Supply Corporation, Ltd. The board shall consist of one authorised representative of each of the companies and local authorities who are for the time being members of this company. Until such directors are appointed, the subscribers are deemed to be the directors of the company. Solicitor: F. G. C. Morris, 40, King Street, Cheapside, E.C.

British Non-Ferrous Metals Research Association (163,067).—Registered January 21st as a company limited by guarantee, not formed for profit. The word "limited" is omitted from the title by licence of the Board of Trade. Objects: To promote research and scientific work in connection with the study, production, treatment and utilisation of non-ferrous metals and alloys, &c. The number of members is unlimited, and each member is liable for not more than £5 in the event of winding up. The first members of the Council are: A. J. Bailey (Sir W. H. Bailey & Co., Ltd., Salford); T. Bolton (T. Bolton & Sons, Ltd., London); C. Cookson (Cookson & Co., Ltd., Newcastle-on-Tyne); J. S. Cornwell, Newton Chambers, Cannon Street, Birmingham (chairman of Bedstead Manufacturers' Federation); J. N. Earle (Earle, Bourne & Co., Ltd., Birmingham); S. Evered (Evered & Co., Ltd., Smethwick); A. P. M. Fleming (Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester); W. W. Gibbins (Birmingham Battery and Metal Co., Ltd.); H. L. Heathcote (Rudge-Whitworth, Ltd., Sparkhill, Birmingham); H. E. Howard (Stewarts & Lloyds, Ltd., Halesowen); R. S. Hutton (Sheffield Flatware Co., Ltd.); J. W. Madeley, 110, Edmund Street, Birmingham; G. H. Muntz (Muntz's Metal Co., Smethwick); W. M. Morrison (British Aluminium Co., Ltd., London); Z. Payne (Phosphor Bronze Co., Ltd., London); H. L. Reason (J. Russell & Co., Ltd., Birmingham); F. Tomlinson (Broughton Copper Co., Ltd., Manchester); A. H. Wiggin (H. Wiggin & Co., Ltd., Birmingham); A. H. Wolseley (C. Clifford & Sons, Ltd., Birmingham). Solicitors: Pinsent & Co., Birmingham.

Castle Engineering Co., Ltd.—Registered January 23rd. Capital, £5,000 in £1 shares (2,500 preference). To carry on the business of mechanical and electrical engineers, manufacturers of and dealers in electric, magnetic, telegraphic, telephonic and other appliances, &c. The subscribers (each with one share) are: E. L. Castle, Holly Mount, Station Road, Pendlebury, electrical engineer; F. C. Lomax, Ennerdale, Campbell Road, Swinton, cotton manufacturer. The first directors are: E. L. Castle, E. W. Castle, F. C. Lomax, and H. Easson (all permanent). Solicitor: J. Knight, 2, Ridgefield, Manchester.

Accumulators of Woking, Ltd. (163,120).—Private company. Registered January 22nd. Capital, £35,000 in £1 shares. To take over the business of Accumulators, Ltd., and to carry on the business of mechanical engineers, machinists, fitters, millwrights, manufacturers of and dealers in electrical batteries and accumulators, &c. The first directors are: H. P. Martin, Lingwood, Gower Road, Weybridge, engineer; H. Fulton, Byways, Berkhampstead, general manager; G. H. Handasyde, The Vines, West Byfleet; L. C. Rawlence, 40, Sackville Street, W., motor engineer Registered office: Maybury Hill, Woking.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Drake & Gorham, Ltd. (70,275).—Return dated December 3rd, 1919. Capital, £125,000 in £1 shares. All shares taken up. £85,000 paid. £40,000 considered as paid. Mortgages and charges, nil.

Lancashire Power Construction Co., Ltd.—Charge on the company's undertaking and property present and future, including uncalled capital, and certain debentures and shares, registered December 6th, 1919, to secure all moneys due or to become due from the company to Lloyd's Bank, not exceeding £50,000.

United Kingdom Lighting Trust, Ltd.—Debenture to secure all moneys due or to become due from company to Barclay's Bank, Ltd., registered December 2nd, 1919, charged on the company's undertaking and property, present and future, including uncalled capital.

CITY NOTES.

British Columbia Electric Railway Co., Ltd.

The report for the year ended June, 1919, shows that after deducting £154,727 for depreciation, sinking fund, and renewals, and £1,818 for addition to capital amortisation fund, the ordinary net revenue from all sources was £224,601, plus £138,419 profit on exchange in remittances from Vancouver to London and moneys formerly set aside for contingencies and now no longer required for such, and £6,085 brought forward, making £369,105. Debenture interest absorbs £132,447; dividend on the 5 per cent. cumulative perpetual preference stock for the year £72,000; dividends, interim and final on the preferred ordinary stock, making 5 per cent. for the year, £72,000; 3 per cent. on the deferred ordinary stock, £43,200; bonus of 3 per cent. on the deferred ordinary stock, £43,200; to be carried forward £6,258. The bonus of 3 per cent. upon the deferred ordinary stock is an exceptional distribution rendered possible this year, as shown by profit on exchange in remitting moneys from Vancouver to London, and by the appropriation of certain moneys held for contingencies which, under the altered conditions, the directors consider may now be safely distributed. In regard to the dividend of 3 per cent. on the deferred ordinary stock, the directors consider that the improvement in local conditions, as reflected in the current earnings, is such as to justify reasonable hope that a distribution on the deferred stock may be maintained. The net earnings of the company for the current year, as compared with the year under review, are as follows:—

	1918. $	1919. $	Increase. $
July	*19,165	149,109	129,944
August	88,436	166,808	78,372
September ...	130.548	181,811	51,263
October	124,326	183,415	59,089
	$362,475	$681,143	$318,668

*NOTE.—Strike in progress for 11 days during July, 1918.

The Bill to establish a Public Utilities Commission became law in March, 1919. Both the terms of the Act and the decisions of the Commissioner have shown every indication of a desire to treat the company with justice. The Act gives a right of appeal from the decision of the Commissioner. There is a special clause relating to the 6 cent fare now being charged on the Vancouver City lines. The Vancouver City Council in July, 1918, granted the company the right to charge a 6 cent fare for a period of nine months. The Public Utilities Act was passed before this period expired and provided for the continuance of the 6 cent fare, subject to the company being able to satisfy the Commissioner that such rate was just and reasonable.

The Act also provides that until such proof is furnished to the satisfaction of the Commission the amount received by the company in excess of the five cent fare previously charged is to be deposited in a special account in a chartered bank in Vancouver, and that if the rate should be fixed at less than six cents the excess amount is to be handed over to the Vancouver General Hospital. Owing to an amendment of the general Railway Act of the Dominion of Canada the railways of the company passed from the jurisdiction of the Province of British Columbia and of the Public Utilities Com-

mission to that of the Dominion of Canada and of the Dominion Railway Board, but it is anticipated that amending legislation will be passed early in 1920 which will place the company's railways again under the jurisdiction of the Public Utilities Commission, and the company has joined with the local authorities in petitioning for this to be done. When this has been done it is expected that an investigation, which was commenced by the Commissioner some time ago to ascertain the correct fare to be charged in Vancouver City, but which, owing to the circumstances reported above, has been temporarily adjourned, will be resumed, and that an appraisal of all the property of the company on the mainland will be made.

In June, 1919, the employés of the company and of most other industries in Vancouver went on strike, not for any increased wages or any improved conditions, but in sympathy with the general unrest which was then prevalent in labour circles throughout Canada, particularly in Winnipeg. The strike lasted from June 5th to 29th, when the men returned to work on the old terms. The revenues of the company on the mainland from its railway system were reduced to almost nothing during the 24 days that this strike lasted. In August, 1919, a request was received for a further increase in wages. This request was submitted to arbitration, and under the arbitration award increases were granted which will cost the company a large sum.

The directors consider that the improved conditions warrant a return to the practice of paying the dividend on the 5 per cent. cumulative perpetual preference stock half-yearly, as before the war, and a half-year's dividend of 2½ per cent. has been declared.

The end of the war and the gradual return to normal conditions is having a good effect upon the company's revenues. In addition to the return of the men who left the Province of British Columbia for overseas service, it is stated that a large number of men who enlisted in other parts of Canada went to British Columbia on being demobilised.

East London Railway Co.—During 1919: passengers carried 12,721,929, against 10,569,541, exclusive of season-ticket holders. State control of railways has operated and continues to operate particularly inequitably—inasmuch as while the Government absorbs the greatly increased receipts due to the electrification of the railway, the company derives no benefit therefrom, but on the contrary is responsible for interest on the amount expended upon the electrification. An appeal was made to the Railway Executive Committee asking for special consideration, and the secretary replied that the Board of Trade were informed that the claim of the company was one which should receive the sympathetic consideration of the Board of Trade and of the Treasury.

British Trade Corporation.—The net profit for 1919, after payment of all expenses and making provision for depreciation of investments and contingencies, amounts to £88,340, plus £14,252 brought forward. The directors recommend a dividend of 8s. per share (subject to tax), leaving £22,592 to be carried forward.

Mather & Platt, Ltd.—A scheme has been prepared for capitalising and distributing £450,000 of the undivided profits, in the shape of new ordinary shares of £1 each. The capital is to be increased by £1,500,000 new shares to £2,500,000 .f resolutions to be submitted at a meeting on February 3rd are agreed to.

Marconi's Wireless Telegraph Co., Ltd.—Dividend on the 7 per cent. cum. part. preference shares of 7 per cent., being 1s. 4.80d. per share, less income tax; on the ordinary shares an interim dividend of 10 per cent., being 2s. per share, less income tax.

Metropolitan Railway Co.—£40,000 is placed to general renewals; a dividend at the rate of 1½ per cent. per annum for the half-year, making 7½ per cent. for the year, is to be paid; and £20,000 is to be carried forward.

Prospectuses.—Industrial Glass Works, Ltd.—The list closes on February 3rd in an issue of 20,000 10 per cent. cum-pref. shares of £1 each at par and 20,000 ordinary shares of 1s. each at par.—Messrs. Erinoid, Ltd., have been offering to shareholders 100,000 shares of 5s. each at a premium of 5s. each.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be officially quoted:—

Edison Swan Electric Co., Ltd.—360,000 ordinary shares of £1 each, fully paid, Nos. 596,308 to 958,307.

Yorkshire (West Riding) Electric Tramway Co., Ltd.—Dividend 6 per cent., less tax, on the cum. pref. shares. There is put to renewals, depreciation and reserve £21,259. Purchase of funded preferential dividend certificates, £12,837. Carried forward, £1,386.

Stothert & Pitt, Ltd.—Interim dividend for the past half-year at the rate of 10 per cent. per annum, free of tax.

Blackpool, St. Annes & Lytham Tramways Co.—Profit for 1919 (to October) £10,093; after meeting debenture charges, the debit balance carried forward amounts to £37,991.

Crossley Bros., Ltd.—An issue of 255,000 of the new ordinary shares is being offered to the existing holders at par.

STOCKS AND SHARES.

TUESDAY EVENING.

THERE is noticeable slackening in Stock Exchange activity, although no check to the outpouring of new issues. Probably the latter has something to do with the former. The Government's appeal that fresh applicants for money should exercise a certain amount of restraint while the subscription lists are open for the new 5½ per cent. bonds has not had much effect, the newcomers sheltering themselves behind the reasonable excuse that they had made their arrangements for issue some time before the Government appeal appeared, and that they were unable to stop their prospectuses. It may be mentioned, in this connection, that when underwriting is being arranged, there is almost invariably a clause to the effect that underwriters are only bound to their obligation provided the prospectus is issued within a certain period, and the time, as a rule, is comparatively close to that on which the underwriting is completed, so that it is likely enough that the excuse is a valid one in most instances.

The first Home Railway dividend announcements exercised a chilling effect upon the market for the stocks. The Metropolitan repeats its performance of last year, which has, incidentally, the effect of throwing into relief the extremely meagre yield afforded by the ordinary stock. The East London Railway figures are not bad, showing traffic increases in passenger and freight traffic, but shareholders get nothing out of the improvement, thanks to the arrangement with the Government. The Railway Executive has promised that the claim of the company to special consideration shall receive sympathy, whatever that may mean.

What is the position of London Tubes may be a little clearer at the end of the week than it is now. Manifestly there is something afoot between the Combine and the Ministry of Transport: and curiosity stirs itself laxily to ask what is likely to happen. The two main questions are: Will the Government take over the Tubes? and, Are the fares going to be doubled? to which the daily strap-hanger adds a third, When shall I get a seat for my money? Market sentiment is reflected in ¼ fall in Underground £10 shares, and 3½ points in the Income Bonds, although such movements might have occurred in the general dulness of Home Railways, irrespective of the questions surrounding control of the four Tubes, three tramway and three omnibus companies concerned in the Combine.

London United Tramways 5 per cent. preference shares of £1 each stand at two and ninepence, and the 4 per cent. debenture stock at 40. South Metropolitan Tramways 4 per cent. debenture is quoted 58. Metropolitan Electric Tramways 4½ per cent. debenture stock is, according to the Stock Exchange official price, 60 to 63, although business was marked at 72 only a week ago, and the company's 5 per cent. debenture stock stands at 73½. London and Suburban Traction ordinary are a florin apiece, the preference 4s. 6d., and the debentures 52 and 71 for 4½ per cent. and five's respectively. Potteries Electric Traction ordinary and preference have come on to the same line at 14s. British Electric Tractions are 40½ and 68½ for ordinary and preference; the two debentures have changed hands this year at 82½ and 64½ for firsts and seconds.

Holders of such stocks and shares may well regard with feelings of envy the proprietors of Bombay Electric ordinary. We mentioned some time ago that the price rose pounds in one day to the neighbourhood of 60. To-day it is £100—indeed, a bargain was marked at 101 on Friday last. Intrinsically it is difficult to see that the shares are worth 20, being of the nominal value of £10. Last year a dividend of 7 per cent. was paid; in the previous twelve months the dividend was 9 per cent. The Stock Exchange market refers the rise to buying for control. A rise of 5s. lifted the preference to 14; they carry 6 per cent. dividend and no participating rights. Other Indian tramway shares are quiet, Calcuttas 8½, Madras preference 4.

Mexicans mostly retreated further, where they moved at all. Mexican Light and Power firsts at 52½ are down 3½. Pachuca Fives are dull at 43, Montereys at 31½. Mexican Electric Light 5 per cent. bonds changed hands at 43¾ on Monday; the deposit receipts at 43. The optimist may be pardoned for thinking he sees a breath of improvement in the market. A little encouragement, and prices would be rapidly up again. South American Light and Power 5 per cent. registered debentures were sold a few days back at 80. Brazilian Tractions continue to give way, and are down to 56. The strength of Anglo-Argentine Tramways yielded to what was termed profit-taking. British Columbia Electric stock spurted on the dividend declaration; a bonus on the deferred was quite unexpected.

The cable market has turned better, and Western Telegraphs at 17½, Eastern ordinary 165½, Anglo-American pre-

ferred 90, "Chinas" and Globes 16¼ show, with slight improvements, the tendency of the market. United River Plate Telephones are higher at 8, but Orientals at 2½ parted with some of their recent advance. Automatic Telephones reacted to 3 5-16. Anglo-Portuguese Telephone ordinary hold their price at 19s. Marconis continue to be neglected, but Canadians spurted to 14s., while Americans lagged behind at 30s. 6d.

Electricity supply shares show scarcely any movements. Although the recent Bill had its fangs drawn, a new Bill is to be presented next session, in which the features objectionable to shareholders in the companies are likely to be repeated, and already a movement is on foot to protest against infringement of the companies' rates. An interesting registration is that of the London Electricity Joint Committee (1920), Ltd., with a nominal capital of £50,000 in £1 shares. The company is a private one, and the two signatories are Mr. W. F. Fladgate and Lord Downham. The objects of the company are to prepare schemes with a view to improvement of organisation of electricity supply within London, Middlesex and adjoining counties or districts.

Edisons were a little lower at 27s., and General Electrics eased off to 41s. Siemens at 29s. 6d. have reacted a trifle. Electric Construction debentures fell 6 to 60. On the other hand, Castner-Kellners have risen to 4 owing to an improvement in Brunner Monds. Henleys are ½ up at 2⅞, Callenders 7s. 6d. higher at ¾ and Telegraph Constructions 10s. to the good at 27. A fair amount of business is being done in the shares of all the manufacturing companies. The rubber market continues quiet, with no object of special interest, and in the metal markets, rises in gold and tin have drawn renewed attention to the companies concerned with the production of both.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Jan. 27, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	8	6⅞	—	£6 16 2
Charing Cross Ordinary	4	4	3	—	6 13 4
do. do. do 4½ Pref.	4½	4½	2¾	—	8 3 8
Chelsea	5	5	3	—	5 0 0
City of London	8	8	1⅜	—	6 3 1
do. do. 6 per cent. Pref.	6	6	1½	—	6 6 4
County of London	7	7	9⅛	— ⅛	7 11 4
do do. 6 per cent. Pref.	6	6	8½	—	6 15 2
Kensington Ordinary	7	6	4⅞	—	6 8 4
London Electric	Nil	Nil	1⅜	—	
do. do. 6 per cent. Pref.	5	5	3⅝	—	8 17 10
Metropolitan	4	5	3⅛	—	7 16 10
do. 4½ per cent. Pref.	4½	4½	2⅝	—	7 16 6
St. James' and Pall Mall	9	10	6	—	8 6 8
South London	5	5	3⅞	—	7 12 8
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	5½	—	7 12 5
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	90	+ ½	6 13 4
do. Def.	1½	83/6	21½		7 1 2
Chile Telephone	8	8	8½	+ ½	6 5 6
Cuba Sub. Ord.	7	7	10⅜	—	*6 18 4
Eastern Extension	8	8	16½	+ ⅜	*4 18 6
Eastern Tel. Ord.	8	8	165⅛	+1	*4 16 8
Globe Tel. and T. Ord.	7	8	16½	+ ½	*4 18 6
do. do. Pref.	6	6	9⅛	+ ⅛	6 6 4
Great Northern Tel.	22	22	23⅝	—	9 7 2
Indo-European	13	13	48½	—	6 13 4
Marconi	20	25	4⅛	— 7/6	6 1 6
Oriental Telephone Ord.	15	10	7⅛	— ⅛	4 11 6
United R. Plate Tel.	8	8	8	+ ⅛	*5 0 0
West India and Panama	1/8	1/8	1,⅛	— 7/6	5 9 6
Western Telegraph	8	8	17½	+ ½	*4 12 9
HOME RAILS.					
Central London Ord. Assented	4	4	83½	—	6 16 9
Metropolitan	1	1½	24½	—1	5 1 6
do. District	Nil	Nil	21	—	Nil
Underground Electric Ordinary	Nil	Nil	3⅜	— ⅛	Nil
do. do. "A"	Nil	Nil	7/6	—	Nil
do. do. Income	4	5	88½	—3½	*5 19 9
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	97	—	7 14 10
Anglo-Arg. Trams. First Pref.	5½	Nil	4	- ¼	—
do. do. 2nd Pref.	—	—	8½	—	—
do. do. 5 Deb.	5	5	65½	—	7 12 8
Brazil Tractions	—	—	56	—3	—
Bombay Electric Pref.	6	6	14	+ ¼	4 5 9
British Columbia Elec. Ry. Pfce.	5	5	64	+3½	7 15 0
do. do. Preferrred	Nil	2½	59½	+3	8 8 0
do. do. Deferred	Nil	Nil	55½	+3	—
do. do. Deb.	4½	4½	64	—	6 15 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	46	—	Nil
do. 6 per cent. Bonds	Nil	Nil	85½	—	Nil
Mexican Light Common	Nil	Nil	22½	—	Nil
do. Pref.	Nil	Nil	36	—	Nil
do. 1st Bonds	Nil	Nil	52½	—3½	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	9⅜	—	*4 9 0
British Aluminium Ord.	10	10	1⅞	—	5 14 3
British Insulated Ord.	25	12½	2⅛	—	5 14 2
Callenders	25	25	9⅜	+ ¾	6 9 10
,, 6½ Pref.	5	6½	4⅞	—	7 2 1
Castner-Kellner	25	20	4	+ ¼	—
Crompton Ord.	7	10	21/6	—	9 6 0
Edison-Swan, "A"	—	10	1⅜	+	7 5 0
do. do. 5 per cent. Deb.	4	5	75½	—	6 5 9
Electric Construction	10	10	1⅛	—	8 8 8
Gen. Elec. Pref.	8	6½	19/-	—6d.	6 16 10
do. Ord.	10	10	41/-	— 1/-	*4 15 3
Henley	25	25	2⅞	+ ½	5 5 3
do. 4½ Pref.	4½	4½	3⅜	—	6 4 2
India-Rubber	10	10	16	—	*6 5 0
Met.-Vickers Pref.	—	—	3½	—	5 14 0
Siemens Ord.	—	10	29/6	—6d.	*6 18 0
Telegraph Con.	20	20	27	+ ½	*4 9 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, January 27th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	...
a Ammoniac Sal	per ton	£95	...
a Ammonia, Muriate (large crystal)	,,	£75	...
a Bisulphide of Carbon	...	...	...
a Borax	,,	£42	£3 inc.
a Copper Sulphate	,,	£48	£4 inc.
a Potash, Chlorate	per lb.	11d.	2d. dec.
a ,, Perchlorate	,,	1/3	...
a Shellac	per cwt.	£44	10/- inc.
a Sulphate of Magnesia	per ton	£15	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	£70/-	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metal 7" to 12" basis)	per lb.	1/3½	½d. dec.
c ,, Tubes (solid drawn)	,,	1/6½ to 1/7	½d. dec.
c ,, Wire, basis	,,	1/5⅝	½d. dec.
c Copper Tubes (solid drawn)	,,	1/9½	½d. dec.
g ,, Bars (best selected)	per ton	£167	...
g ,, Sheet	,,	£167	...
g ,, Rod	,,	£167	...
d ,, (Electrolytic) Bars	,,	£125	...
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£140	...
d ,, ,, H.C. Wire	per lb.	1/5½	...
f Ebonite Rod	,,	3/-	...
f ,, Sheet	,,	2/6	...
h German Silver Wire	,,	2/9	...
h Gutta-percha, fine	,,	13/-	...
h India-rubber, Para fine	,,	2/7½	...
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£48 10/-	...
g Lead, English Pig	,,	£47 15/-	15/- dec.
g Mercury	per bot.	£23	10/- dec.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/8 to 2/-	...
g ,, ,, rolled bars and rods	,,	2/3 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/8 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11	...
r Steel, Magnet, in bars	per ton	...	...
g Tin, Block (English)	,,	£387 to £388	£9 to £10 inc.
n ,, Wire, Nos. 1 to 16	per lb.	5/-	...
White Anti-friction Metals	per ton	£90 to £845	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Zinc Smelting.—In a review of the spelter situation in *The Journal of the Society of Chemical Industry* Mr. H. M. Ridge says that until conditions improve we are dependent on American supplies. Owing to the necessity of preference being given to the shipment of foodstuffs, wool and other essential commodities, zinc ore is being shut out, and there seems no prospect of the British or Belgian works being able to run their furnaces at full capacity during the coming months.

During the war zinc smelting was classified as one of the important key industries, but no steps have yet been taken to make the country self-supporting, although ample supplies of ore are available within the Empire.

In the treatment of zinc concentrates no radically new methods have yet proved suitable. Electrolytic precipitation has been tried in a number of works in the country, but all of these have been shut down, including the Hoepfner process plant at Winnington, from which such a good product was obtained for several years. It is interesting to note that at the same time electrolysis has been adopted for the new plants in Tasmania, Canada, and at one works in the United States, but in each of these cheap power is available. The demand for high-grade zinc will be large in future, but it can now be obtained cheaply by new means which were worked out during the war. Much progress has been made with the electric furnace reduction in Norway, Sweden, and France, and the troubles experienced in the condensation of the zinc vapour have been largely overcome, but here also cheap power is essential.

Charging the pots in the furnace probably used to be the most laborious work of the zinc smelter, and this has been overcome with the aid of charging machines. These are driven electrically, and are much more efficient than hand charging, the pots being more uniformly charged and the charge denser. The duration of the manœuvre is shortened by about two hours.

The more extensive use of machinery reduces the number of men, and at the same time makes the management more independent of the skilled workmen.

TRANSFORMERS FOR ELECTRIC FURNACES.

By J. LINDLEY THOMPSON. M.Sc., A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

Electric furnaces in commercial use at the present time may be classified under four heads: (1) Radiation arc type for steel; (2) conduction arc type for steel; (3) induction type for steel; (4) resistance type for carbide, carborundum and ferro-silicon. With furnaces under types (1), (2), and (4), transformers are nearly always required, while type (3) is in itself a static transformer.

The induction furnace has not made much progress, and this country is almost entirely unfamiliar with its service conditions.

With both arc and resistance furnaces transformers are in general use. The electrical characteristics of the transformers for the two types of furnace differ somewhat, but their construction is on similar lines. Various troubles were experienced with transformers built to early designs when put into operation, and they were briefly as follows: (1) Loss of L.P. voltage across the arc due to bad lay-out of leads, or to reactance values of the transformers being too high. (2) Failure of insulation of switchgear and transformer terminals on the H.P. side due to the heavy auto-transformer effect in consequence of the large range of voltage. (3) Mechanical damage to coils in the transformers due to frequent current-rushes. (4) Unbalanced voltages on the L.P. side of Scott-connected transformers due to unscientific design. (5) Failure of transformers due to bad housing, unskilled operation, and heavy overloads. With the experience of the past few years and a careful study of the conditions of service on site, the above causes of trouble have been practically eliminated. Since the steel furnace is that which is most common and causes most criticism, it is with transformers for this condition of service that the author mainly deals.

Furnaces in general require a minimum of three L.T. pressures for use at different stages of production. The transformers must be provided with a certain amount of reactance for steadying the arc and reducing the rush of current to safe values in the transformer windings and supply mains. This reactance may be internal or external. It is necessary to reinforce heavily the end turns of the high-pressure windings, also extra insulation between the remaining turns is advisable, especially where tappings are brought out. The tappings for voltage variation should be on the H.P. side, for due to the few turns on the L.P. side, correct voltages cannot readily be obtained. The switchgear problem is also simplified by the use of H.P. tappings, which should be in the middle of the winding. The ratio of iron to copper loss is not important.

Coils connected in parallel should be so placed that they are equally loaded under all conditions of service. The transformer must be of sound mechanical construction with its coils rigidly supported in all directions in which movement is possible under a heavy rush of current. All leads, high and low pressure, should be securely clamped to prevent movement due to heavy current rushes. The insulating material should be strong and firmly held in position, being assembled with the coils and secured while under pressure. Numerous ventilating ducts should be provided by means of suitably arranged spacing blocks between the several coils to prevent local heating. Only the H.P. leads required should be brought out of the case, the remainder being retained under oil level. The high-pressure line leads should be brought through individual insulators. The L.P. leads should be increased in section, from two or three inches under oil level, to prevent heating.

Self-cooled transformers should be placed in well-ventilated chambers with a minimum distance between them of 18 in. for sizes up to 1,000 K.V.A. and 24 in. for larger sizes. They should be kept clean, easy of access, and be placed as near to the furnace as possible and symmetrical, with a fireproof barrier between them and the furnace. Unskilled attention has been the cause of serious trouble. The L.P. leads should be as near together as possible, and interleaved for currents higher than 5,000 amperes.

Transformers for furnace work are manufactured of both the core and shell-type construction, and both are giving good service.

Up to the present time, electric steel furnaces have been designed and built for dealing with quantities up to about 15 tons, but the future will demand larger sizes up to 30 or 40 tons' capacity. Taking the kilovolt-amperes required per ton at 200, then transformer groups of 6,000 to 8,000 K.V.A. will be required. The problem of transforming this amount of power is not unreasonable, since power transformers for dealing with much larger capacities have been manufactured.

There are several alternatives whereby this increased power can be supplied to the furnace: (1) Power can be increased by increasing the currents at the present voltage values, and subdividing this current into two or more parallel paths through the furnace. With an 8,000-K.V.A. furnace at 85 volts to the bath, over 47,000 amperes per phase for a two-phase, and over 31,000 amperes for a three-phase furnace will be required. Transformers for dealing with such currents can be designed and manufactured, but only the furnace designers can give expert opinion on the possibility of providing for the numerous electrodes in the roof structure of the furnace. (2) Power can be increased by raising the voltage between the electrode and the bath. The possibility of this suggestion is dependent on the roof lining of the furnace. Here again is a problem for the furnace designer, as the transformers present no difficulties. (3) The third alternative, that of increasing the

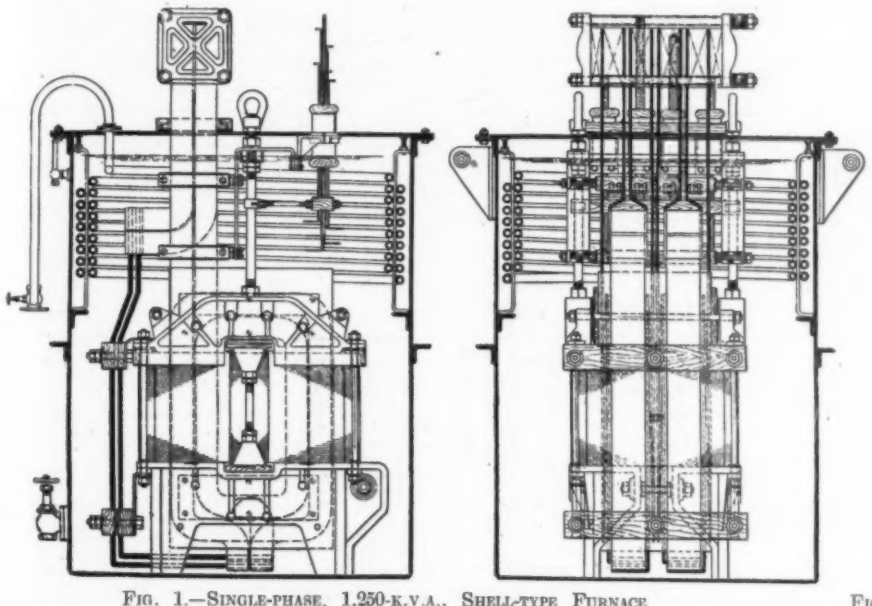

Fig. 1.—Single-phase, 1,250-K.V.A., Shell-type Furnace Transformer; 1¼ turns on L.T. Winding.

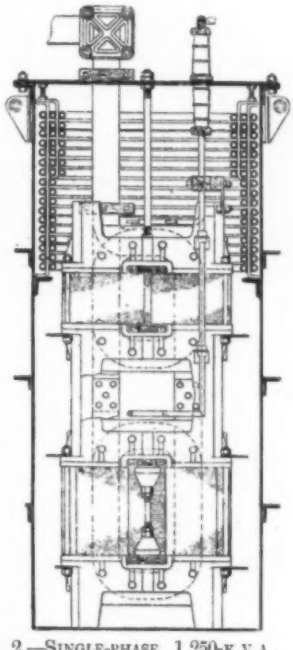

Fig. 2.—Single-phase, 1,250-K.V.A., Shell-type Furnace Transformer, with L.T. Booster.

number of phases, seems to be the one favoured by furnace designers. Up to the present time, the author is under the impression that in this country the maximum number of phases used in a steel furnace has been three. Furnaces for four, six, and eight phases have been designed and various transformer connections suggested and patented to obtain these requirements. None of these, however, has had, as far as the author is aware, any practical commercial trial up to the present.

The practical limit of size for an electric furnace will, in the author's opinion, be a compromise between all three alternatives and will depend on: (1) The maximum current that can possibly be carried per electrode. (2) The maximum voltage that can be sustained across the arc without destroying the roof. (3) The maximum number of electrodes that can be installed without danger to the roof.

The fundamental principles underlying the design of large furnace transformers are the same as those in power transformers, but due to the large currents, special reactance and possible intricate connections, special attention must be given to their design. In a straight transformer the designer's chief problem is the arrangement of the parallel low-pressure conductors.

This is more difficult of solution the larger the size of the unit and the higher value of current to be catered for. As the size of unit becomes larger, the core section becomes greater, and consequently the L.P. turns become few in number, which is more pronounced with shell-type than with core-type transformers, for considering the same size of unit the section of the shell is generally much larger than that of the core type for economical proportions of active material. In large shell-type transformers, the choice of the number of L.P. turns often lies between one and two. If one turn is used, then a large iron section is necessary; or if two be used, a large

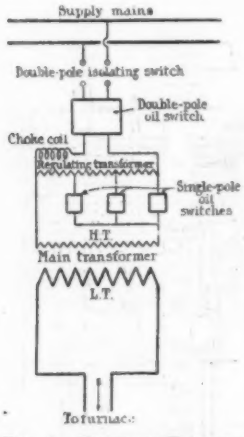

FIG. 3.—FURNACE TRANSFORMER WITH H.T. AUTO-REGULATING TRANSFORMER AND EXTERNAL REACTANCE.

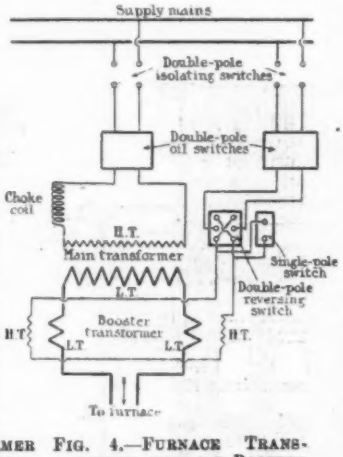

FIG. 4.—FURNACE TRANSFORMER WITH L.T. BOOSTER AND EXTERNAL REACTANCE.

weight of copper is required, while neither will give economic proportions of active material and minimum losses. If one and a half turns be used, as described in the author's patent No. 131,026, a proportion of active material nearer to the economical value can be obtained (fig. 1).

In order to simplify the design and manufacture of furnace transformers, and especially those for heavy currents, it is desirable to increase the number of L.P. coils in parallel, thus reducing the reactance value of the transformer. A transformer of low reactance, while satisfactory for resistance furnaces, is unsafe for arc furnaces, hence the transformer reactance would have to be supplemented by an external reactance in either the L.P. and H.P. side. An ideal transformer would also be one as simple as possible having no tappings. If voltage variation on the L.P. side is required, this would be obtained by means of a regulating transformer (fig. 3), a booster (figs. 2 and 4)), or an induction regulator.

Furnace transformers and the alternative auxiliaries above mentioned are suitable for all types of furnace, since the reactance being external can be varied at will or cut out.

The ideal furnace transformer is, in the author's opinion, a simple transformer of one voltage ratio with a moderate reactance. The necessary auxiliaries for voltage requirements and safe working are, an external reactance on the line side of the high-pressure winding, a regulating transformer, a booster transformer, or an induction regulator for voltage variation.

A great deal has been said on various occasions concerning the heavy stresses to which furnace transformers are subjected. While this in a measure is true, it should not be interpreted to mean that the mechanical forces exerted on the transformers are of extremely high value, but that during operation frequent and repeated stresses of a moderate value are exerted. These stresses take place frequently during the melting period, and are brought to bear on the coils and leads.

A 2,000-K.V.A., 25-period, single-phase, shell-type transformer, having a reactance of 7 per cent., will, if short-circuited directly across its secondary leads, allow a current of approximately 14.3 times its full-load current to flow provided the supply voltage is maintained. This current brings a mechanical stress to bear on the coils in an axial direction of approximately 60 tons. If the transformer is supplying a furnace and during the melting period (power factor 0.8) is short-circuited by the electrode coming into direct contact with the bath, the short-circuit current that will flow will be 1.6 times full load since the reactance in circuit is 60 per cent., *i.e.*, 7 per cent. in the transformer+53 per cent. in the furnace lay-out. The mechanical stress due to this current is approximately 0.3 ton on the coils in an axial direction. If the short-circuit occurs during the molten period, *i.e.*, power factor=0.9, the short-circuit current is 2.3 times full load, for the reactance in circuit is now approximately 43.5 per cent., *i.e.*, 7 per cent. in the transformer and 36.5 per cent. in the furnace and lay-out. This current brings a mechanical stress of approximately 0.8 ton on to the coils in an axial direction. The figures of stress are those on the coil surface.

The satisfactory operation of electric furnaces is not dependent solely on the transformers being of correct design and sound construction, but also on the relative positions of transformers and furnace and the heavy current connections between them. The effects of a bad lay-out are chiefly: Low operating power factors, hence inefficient working and a possible loss of useful working voltage. Heating up of leads, clamps, and cables. Unbalancing of voltages on the furnace

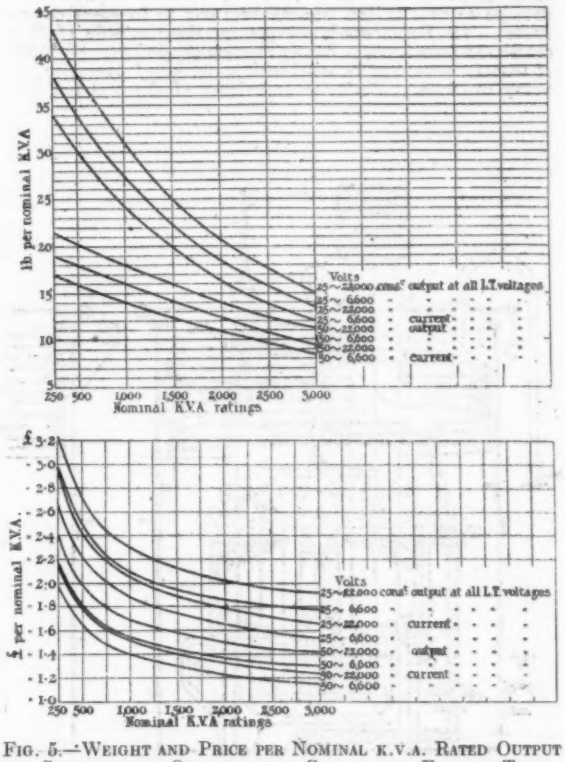

FIG. 5.—WEIGHT AND PRICE PER NOMINAL K.V.A. RATED OUTPUT FOR SINGLE-PHASE, OIL-INSULATED, SELF-COOLED FURNACE TRANSFORMERS WITH L.P. RANGE OF 1 TO 1.31.

and unbalanced load currents and phase relation on the supply side of the transformers. The chief cause of lay-out trouble is that the inductance of the leads on the low-pressure side between the transformers and the furnace is either too high or unequal in the different phases.

In order to reduce the possibility of a heavy choking effect and unbalanced voltages, the following suggestions will be helpful: (1) The transformer or transformers should be placed as near to the furnace as possible, so that the heavy L.P. leads may be of minimum length. (2) The L.P. leads of the various phases should be symmetrically placed with respect to the transformers and furnace. This is essential so that the leads of each phase may be of approximately the same length, and also that the area enveloped in each phase should be equal and hence the inductance of each phase equal. (3) The area between the positive and negative L.P. leads should be as small as possible, and also that between phases, in order that the inductance may be a minimum or of a practicable value. (4) The L.P. leads for heavy currents (above 5,000 amperes) should be in multiple and interleaved from the transformer to a point as near the furnace as possible. This will keep the inductance down to a low value and make that of each lead approximately the same, thus ensuring that each parallel lead takes its proper share of the load. (5) The heavy current leads should not be run near any heavy magnetic structure such as girders or

supporting columns, unless both the positive and negative leads are run together and interleaved. (6) No magnetic material should form a closed circuit around any positive or negative conductor, or heavy currents will be induced in that circuit. The positive and negative conductors interleaved may be run through a magnetic circuit. Clamps for heavy current leads should be of non-magnetic material.

From the point of view of lay-out, it is possible that a maximum current limit will be reached for satisfactory operation. This limit is suggested by the fact that with heavier currents more latitude is required as regards loop area for the accommodation of the leads, and especially is this the case where they become flexible so as to allow movement of the electrode and the flexibles attached to them.

The 2,000-K.V.A. furnace transformer already referred to under the best working conditions has an operating power factor of 0.92. The lay-out then has an inductive drop of approximately 39 per cent. for a current of 23,500 amperes at a terminal voltage of 85. This inductive drop can be split up into transformer inductive drop of 7 per cent. and lay-out inductive drop of 32 per cent. The above figures are those for an average case and represent a fairly good lay-out that cannot be much improved. Now suppose the transformer, leads, and furnace be replaced by one of 5,000 K.V.A. the transformer having the same reactance value of 7 per cent. Taking the lay-out to be similar to the 2,000 K.V.A. unit, but of heavier copper section, the loop area the same, though in practice it would have to be larger, then the following would result. The load current is now 58,800 amperes with a terminal voltage of 85. This will cause an inductive drop of $32 \times 58,800/23,500 = 80$ per cent. or a total of 87 per cent. approximately, including the transformer. This results in the voltage across the furnace being only 49 per cent. of the terminal voltage, *i.e.*, 41.6 volts and an operating power factor of 0.49. Thus although, for the same type of lay-out, the K.V.A. output has been increased from 2,000 to 5,000, *i.e.*, 150 per cent., the power factor has dropped from 0.92 to 0.49, and the energy has only been increased from 1,840 to 2,450 KW., or 33 per cent. Actual experiences similar to the above example are not uncommon, and point to a limitation of furnace size on account of limitations in lay-out. In other words, a lay-out suitable for a 2,000 K.V.A. unit is not suitable for a 5,000 K.V.A. unit.

The inefficient results given in the example above may be partially overcome by increasing the voltage on the L.P. terminals, so that the resultant voltage across the furnace may be equal to that for the smaller unit. For the 2,000 K.V.A. unit the terminal voltage is 85 and the furnace voltage 0.92 of 85, *i.e.*, 78.2 (neglecting resistance drop), while for the 5,000 K.V.A. unit the furnace voltage is only 0.49 of 85, or 41.6 volts. Now suppose the terminal voltage of the 5,000 K.V.A. unit be 101 instead of 85, the load current would be then reduced to 49,500 amperes. The inductive drop in the lay-out would be $32 \times 49,500/23,500 \times 85/100 = 56.6$ per cent.

The total inductive drop would be $7 + 56.6 = 63.6$ per cent., and so the operating power factor would be 0.77 and the voltage across the furnace $0.77 \times 101 = 77.8$ volts. As a result of increasing the terminal voltage, the increasing of the K.V.A. rating from 2,000 to 5,000 has increased the power from 1,840 to 3,850 KW., *i.e.*, 109 per cent., which is an improvement as against increased current only. It will be noticed, however, that the power factor has fallen from 0.92 to 0.77, which is a low figure, and points to the limitation of current capacity and lay-out already suggested.

The cost and weight of furnace transformers are dependent on the maximum L.P. current and the voltage variation required, apart from the variables of voltage and frequency. In general, the furnace transformer K.V.A. rating is a figure much below that for a power transformer of the same weight.

Approximate prices and weights are given in the curves (fig. 5) for transformers whose voltage variation is obtained by means of tappings. For furnace transformers complete with boosters or regulating transformers, the prices would have to be increased 10 to 15 per cent.

In conclusion the author wishes to express his thanks to Messrs. The Metropolitan-Vickers Electrical Co. for their assistance in the preparation of this paper.

DISCUSSION IN LONDON.

MR. H. M. SAYERS described furnace transformers as caricatures of power transformers; the conditions to be fulfilled were abnormal, and the design, therefore, differed a good deal from that of ordinary transformers. In the early days the specifications to which designers had to work were unnatural as the necessary conditions were not known. Furnace transformers were very similar to those used for resistance welding, only in the latter the ratio of turns to current was still more exaggerated. It was now the practice in many cases for the whole of the welding apparatus, including the transformer, to be designed by one person, and in the speaker's opinion it was very desirable for this method to be adopted also in the case of furnace transformers. With regard to voltage regulation on the low-pressure side, the rational method was undoubtedly by means of a booster as described by the author; this would help also to keep up the power factor. The author apparently preferred to keep to one flux path, but the speaker thought it would be advantageous to split it up. This would possibly increase the iron and copper, but it would make possible a better disposition of the leads. Amongst other advantages would be that of better cooling; a larger tank would have to be provided, but that would improve the circulation of the oil. The preference for the shell type of transformer from the designer's point of view, as well as from that of price, could be readily understood, but the operating engineer would favour the core type on account of the greater facilities for inspection and repair of coils. With regard to the future, they would require capacities of not 6,000, but more like 60,000 K.V.A. in a lump, not, of course, supplied by one transformer.

MAJOR A. M. TAYLOR thought the paper most useful in that it explained in such detail the exact location of the reactance in the secondary circuit. It appeared, from the figures given, that a serious short-circuit on the secondary side comparable with those which might obtain in power transformers, could not take place, at any rate in the furnace itself. This seemed to be at variance with other statements. If the primary of the booster (or better, of an additional booster) were connected across the phase in advance of that to which the main transformer was connected, an E.M.F. would be injected into the main transformer circuit which could be arranged to bring the power factor of that circuit up to unity at the expense of the power factor of the primary circuit of the said booster. There would be no advantage in such an arrangement unless a separate feeder were available to carry back the lagging current to the generating station. In such a case a special motor-driven generator could be provided to supply this wattless current for the whole system. The advantage of this would be that the regulation on the principal system, to which lights and motors were connected, would be greatly improved, as the principal system could be worked at unity power factor. He, the speaker, had experimentally proved the complete practicability of passing 50-period currents over the conductors of a 25-period system, with complete non-interference of the two systems; hence, by installing 25-period generators, an existing 50-period system could link up with a neighbouring 25-period system, and at the same time take on a 25-period load, or *vice-versa*.

MR. S. E. FEDDEN contragulated the author on his paper, which contained much useful information, as did also his other paper on power transformers, recently read at Leeds.* His experience at Sheffield had been that all H.T. tappings had proved a failure, especially with Scott-connected transformers; they had broken down and resulted in flash-overs. With regard to the author's statement that they would in the future require transformers of 8,000 K.V.A. capacity, the speaker thought it would be preferable to employ four units of 2,000 K.V.A. each instead of one, as experience at Sheffield had taught them that it was advisable to divide up the transformers. The lay-out was a matter of very much importance; the first furnace installed at Sheffield when started up, although all instruments showed full load, received very little power at the electrodes, and the cause was only discovered by someone leaning up against an iron girder, near which the leads passed, and nearly burning himself. The intricate Scott and double-Scott connections referred to in the paper were entirely unnatural, and surely anything that went against nature would never prove satisfactory. The author's method of regulation by means of a booster was certainly much more desirable than the employment of tappings. With modern means of regulation no trouble should be experienced through furnace disturbances. At Sheffield they had had fluctuations of as much as 6,000 KW. several times a minute, and although when one machine only was run difficulty was experienced, it was found that when four or more machines were on load it was possible to entirely dispense with the regulators; the machines regulated themselves quite satisfactorily.

MR. R. G. MERCER explained that in the early days trouble was caused by the transformer makers and furnace users not appreciating the conditions to be fulfilled, and the stresses liable to occur in transformers. In the past, transformers of a much too small K.V.A. capacity had been installed by the users, they being encouraged to do so by the transformer makers guaranteeing the transformers to work satisfactorily under considerable overloads for long periods. This was a great mistake, and bad policy, as the conditions to be fulfilled were entirely different to those of ordinary power supply. To-day, however, new conditions obtained, and with automatic voltage control the old troubles could be entirely avoided. The firm with which he was at present connected had installed the largest electric furnace in the country, of 15 tons capacity, and it worked perfectly. Freedom from surges was entirely due to the automatic regulator which took care of the melting stages. When users installed too small transformers they got what was known as "heat draining" back on to the transformers, which resulted in a rise in temperature and sludging of the oil. He had known cases where transformers had been nearly destroyed by this "pumping," and they had only just been saved in time.

DR. S. P. SMITH inquired why it was desired to have the reactance in the transformer itself, was it a question of safeguarding it? There were many reasons why the core type of transformer was preferable; in the case where 1½ coils

* ELEC. REV., May 9th and 16th, 1919.

were employed, would it not be possible to make them concentric? It was rather a surprise to him to hear the use of sandwich coils advocated, as they would thereby have higher reactance, also would not the proposed booster result in a higher reactance?

MR. J. R. COWIE thanked the author for his very fine paper. The core type of transformer had, in his opinion, only one advantage, and that was the facility for carrying out repairs. It would have added much to the value of the paper if the author had included more figures concerning efficiency, &c., of shell-type transformers. The problem of large transformers would, he thought, have to be faced; in the future large furnace installations the difficulties and cost of transmitting power to the site would be considerable. He had recently worked out figures in this connection, and had found that the cost of 11,000-volt cable and switch gear would be very high.

MR. J. LINDLEY THOMPSON, in reply, agreed that designers laboured under a great disability in the early days. The question of lay-out was of the most importance, but although he made attempts to be allowed to design the original lay-out as well as the transformers, it had never been agreed to. Faults entirely due to the lay-out were often placed on the shoulders of the transformer designers. In one case the transformers were stated to be the cause of the plant having a power factor of only 0.6, but when certain alterations had been made to the lay-out the P.F. at once rose to 0.8. With regard to the suggestion that the tappings should be made at the neutral point, a large percentage of furnaces worked on 2-phase, and there was, therefore, no neutral point, also they had to balance on the L.T. side. The use of 1½ turns in the transformer was in reality the equivalent of splitting up the flux path. The failure of shell-type transformers was very much less than that of the core type. During the war he had seen a shell-type transformer that had taken so long to deliver that on arrival it was green with mould. No difficulty was experienced in thoroughly drying it out, and it had since worked for 12 months satisfactorily. There was no difficulty in working electric furnaces at supply frequencies of from 25 to 60 cycles per sec., but the users maintained that the best results were obtained at 50 cycles. Personally he did not like Scott connections; they were not scientific, and with them were so many things to think of, that a small slip might easily be made that would result in disaster. Transformers had been known to burn out due to bad handling of the furnace and to unequal loading of the two halves of the transformer. There was always much to be learned from failures, and the present-day transformer was the result of failures in the past. With regard to the statement that transformers with 1½ turns had been in use for some years, all he could say was that the Patent Office did not seem to have any knowledge of the fact.

FAILURES OF TURBO-GENERATORS, AND SUGGESTIONS FOR IMPROVEMENTS.

ON January 13th Mr. J. Shepherd's paper was discussed by the NORTH-WESTERN CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS at Manchester. An abstract of the paper was concluded in our last issue.

MR. J. S. PECK said that there were more troubles in the early days of turbo-alternators than there were to-day. The method of bracing in general use was such that an alternator might be short-circuited across its terminals with a very small distortion of the windings. His firm had found it better to use sweated joints for the end connectors than machine-welded joints; it was extremely difficult to tell whether a weld was perfect or not. Their general practice had been not to laminate the stator bars so finely as some makers had done, but to transpose the bars inside the slot, so that each bar occupied a symmetrical position in the slot. In that case the ends of these conductors in parallel could be sweated together. Thus far no thoroughly satisfactory fireproof insulation had been found for the end winding; the use of automatic devices which, in the event of trouble occurring in the alternator, would instantly disconnect the machine from the busbars and at the same time break the field was becoming general, and where this was done the damage was generally something which could be repaired in a very short time. With regard to Mr. Shepherd's proposed water-cooling system, he foresaw many difficulties. It was extremely difficult to insulate the windings so that they could be clamped against the supports. Welded joints were very treacherous things. Once the joint started leaking in a machine of this kind disaster was almost certain to result. He would have a great hesitancy in attempting to build a machine with hundreds of joints which must be watertight.

DR. MILES WALKER said that in applying water cooling to stators the fundamental difficulty was that one had a perfectly closed metal pipe. The only way was to break up the water-cooling system with insulated sections, and when one did that one immediately got a troublesome joint. Water cooling of stators would probably come in the future, but its application to the end connectors was a very difficult problem. With regard to the saving effected, it would surprise him if they could get £17,000.

MR. SHEPHERD gave the exact figures: 5 per cent. loss on a 10,000-KW. machine represented 303 tons of coal per annum, worth at to-day's prices £757. At 6 per cent. compound interest for 15 years that represented £17,500.

MR. SILLS, referring to the side slip of rotor coils, said that the coils must be most accurately formed, so that they actually occupied the radial position in running, otherwise stresses were set up. All manufacturers now made sure that there was going to be no movement after the set was put into operation. With regard to the lamination of the stator, the troubles in the past were in some respects due not only to the failure of the jig room, but also to faulty erection, owing to the assembling of a machine on site when really it ought to be done under skilled supervision. With a really first-class tool room they could turn out first-class jigs and dies to get over the trouble. The stator might be heated while being built, three or four times if necessary. This took time, but it got over the loose cores. The latest idea in one machine was to use cast steel instead of the usual cast iron at the end of the core. It seemed advisable not only to have a wet-air filter, but also a dry-air filter between the machine and the wet-air filter. The dry one need not be of the large size that it was at present.

MR. G. A. JUCHLIN said he had never met a case where side slip had occurred in a properly designed rotor. With regard to the question of air dampers, they were gradually moving in the direction of using a closed air circuit. In such a case, if a breakdown occurred in a stator winding and fire took place, the oxygen in the air would soon be used up, and the air would not support the fire. Recent tests made on large generators indicated an extraordinarily uniform temperature all along the core. Attempts were being made by means of thermo-couples to show what the internal temperatures of the machines actually were. Loose cores were a thing of the past. Recent information showed that mica insulation on the bars would withstand very much higher temperatures than those indicated in the paper. He thought that full appreciation had not been given to the fact that the greatest drop of temperature took place in the insulation and in the air spaces. A small air space would give an enormous temperature drop. It was an exceedingly difficult thing to get close contact between the supports of the coils and the coils themselves. A great thickness of insulation would be required on the end connections in the author's design, and in all probability the temperature would be higher than in an air-cooled machine. Another very serious difficulty introduced by the coil supports was the question of expansion.

MR. H. C. LAMB said that in a modern station equipped with the best bethods of heating feed water the saving on the coal consumption due to the recovery of heat from the generator would amount to something less than half of one per cent. Cloth filters gave a great deal of trouble in cleaning and renewing the cloth, which very soon rotted, and wet filters had high maintenance costs, so that the water-cooled machine was certainly the ideal; but he thought Mr. Shepherd had given an exaggerated importance to the dangers and troubles which existed with air-cooled machines. He had looked up the records of certain turbo-generator plant with which he had been connected for a number of years, which had grown during the last eight years from 20,000 KW. to 100,000 KW. During that period there had only been two cases of faults on stator windings, and in no case could the fault be attributed really to the alternator itself. In one instance the turbine thrust block gave way; the set was automatically cut off from the bars, the field current was cut off, and the damage done was trifling. In the second instance through an accident some steam was turned into the air intake, and naturally the alternator broke down. Again the damage was repaired in a very short time. In that period of eight years there had been two rotor faults. In one case the rotor went to earth. It was during the war, and the machine could not be spared; it ran on for two years with an earth on the winding. When it was eventually sent away for repair, it was found that the fault was due to the winding moving in a slot, and of course it had to be rewound. The other rotor fault was also quite a small matter of insulation breakdown on the end turns. These generators, ten in number, had many times been on short circuit, in some cases on short-circuit direct on to the busbars, but so far as they had been able to discover, never in any case had any winding suffered on account of short-circuit. They could never trace any movement of the coils or the end connections. They simply found it necessary to clean the winding, clean out all the ventilation slots, and revarnish the machine. If he carried the period back to ten years he would have to admit four more cases of stator fault. One of those was due to a defective joint. The other three faults were all due to the burning out of the cotton insulation between the turns of the winding. In a low-speed plant of 1,700 KW. over a period of 15 years the number of faults which occurred was really very great, there must have been during that time 40 or 50 stator faults. That was entirely due to the cotton insulation on the turns of the winding in the slots. During eight years the maintenance costs for plant which was now 100,000 KW. worked out at 0.3d. per 1,000 KW.-hours. In comparison with that the maintenance cost of a low-speed generator for 15

years worked out at 1½d. per 1,000 KW.-hours—five times as much.

MR. H. RATCLIFFE, referring to reactance, thought the correct thing was to have a moderate amount of reactance in the machine, from 10 to 15 per cent., and in addition, suitably to divide the system either by reactances between the bus-bar sections or between the bus-bar section and the tie bar. Heavy short-circuit currents resulted in the creation of strong magnetic fields in the reactance portion of the circuit, accompanied by an enormous mechanical force on the conductors forming that portion of the circuit. Therefore there should be some advantage in removing that reactance field and the resulting strains from the machine, and transferring them to a device which had been designed especially to deal with these matters. Machines should be designed so that internal faults invariably developed or started as faults to earth instead of faults between phases. If they could ensure that, the protection of machines would immediately be very much simplified, and consequently the protection of the system as well.

MR. J. A. KUYSER said that there was no difficulty in cooling large stators. In the case of a rotor, the temperature rise might be, say, 100 deg. Of these 100 deg., quite 70 deg. or 80 deg. were taken up in the insulation. By water cooling the temperature rise might be, say, 5 deg., and the total temperature would be reduced from 100 deg. to 75 deg. or 85 deg. To get the full benefit from water cooling it would be advisable also to reduce the heat of the insulation. This could be done perhaps by increasing the number of slots in the rotor. Another possibility was to use oil cooling instead of water cooling, and to bring the oil in direct contact with the copper. Cooling water was, of course, subject to centrifugal forces, and hydrostatic pressure would be created in the cooling water, amounting to as much as 1,000 lb. per sq. in. As regarded the stator conductors, he agreed that the laminations should not be carried any further than was absolutely necessary to reduce the heating to a reasonable value. He had got good results with a system of radial ventilation. The temperature of the stator was taken the whole length of the core; the maximum temperature was 38 deg., or far more than 50 per cent. in excess of the average temperature.

MR. C. BAUMANN said the author claimed a saving of heat worth £17,000; it was not £17,000 but £1,700. The heat in the alternator was heat at a very low temperature, of very little use.

MR. SHEPHERD, in reply, pointed out that all the drawings which showed water cooling must be taken as diagrams and not working drawings. It was wonderful to think that new type of machinery, which 20 years ago no one would buy, had in 15 years put on one side the high-class low-speed engines for which Lancashire was so famous. The high-speed alternator had developed faster in 15 years than the low-speed engine developed in 50 years. With regard to welded against sweated joints, if they could get a construction so that they could join the conductors turn by turn, he thought a fusion-welded joint was better than any sweated joint. The idea of the paper was to suggest other ways of looking at alternator design in the near future than the present methods, and fusion-welding was used every day for methods of construction as difficult as any proposed in the paper. The heat which they would save from a machine was a secondary matter; nobody would introduce water cooling in turbo-generators from the point of view of recovering the heat. The problem was to build a stronger machine, a better machine, a machine which should be fireproof, and one which would allow the user to have some idea of what was going on within it.

TRADE STATISTICS OF AUSTRALIA.

THE following figures, showing the imports of electrical and allied goods into Australia during the twelve months ending June 30th, 1918, are taken from the recently-issued official trade statistics. The figures for 1913, being the last normal year of trade, have been given for purposes of comparison, and notes of increases or decreases have been added. The 1916-17 figures were published on p. 430 of our issue of November 1st, 1918.

	1913. £	1917-8. £	Inc. or Dec. £
Gas and oil engines.—			
From United Kingdom ...	148,000	12,000	– 136,000
,, United States ...	38,000	77,000	+ 39,000
,, Sweden	2,000	2,000	—
,, Other countries ...	4,000	9,000*	+ 5,000
Total	192,000	100,000	– 92,000
* Canada £9,000.			
Portable and traction engines.—			
From United Kingdom ...	87,000	5,000	– 82,000
,, United States ...	56,000	9,000	– 47,000
Total	143,000	14,000	– 129,000
Dynamo-electric machines up to 200 h.p., static transformers, coils, &c.—			
From United Kingdom ...	168,000	66,000	– 102,000
,, Italy	5,000	5,000	—
,, Sweden	9,000	6,000	– 3,000
,, United States ...	154,000	176,000	+ 22,000
,, Other countries ...	57,000*	2,000	– 55,000
Total	393,000	255,000	– 138,000
* Germany £48,000.			
Dynamo-electric machines over 200 h.p. and parts.—			
From United Kingdom ...	56,000	9,000	– 47,000
,, United States	10,000	13,000	+ 3,000
Total	66,000	22,000	– 44,000
Regulating, starting, and controlling apparatus.—			
From United Kingdom ...	26,000	23,000	– 3,000
,, United States	39,000	35,000	– 4,000
,, Other countries ...	9,000*	—	– 9,000
Total	74,000	58,000	– 16,000
* Germany £7,000.			
Electroliers, gasoliers, &c.—			
From United Kingdom ...	36,000	2,000	– 34,000
,, United States	2,000	6,000	+ 4,000
Total	38,000	8,000	– 30,000
Lamps and lampware.—			
From United Kingdom ...	57,000	27,000	– 30,000
,, Japan	—	19,000	+ 19,000
,, United States	47,000	61,000	+ 14,000
,, Other countries ...	50,000*	7,000‡	– 43,000
Total	154,000	114,000	– 40,000
* Germany £41,000. ‡ Canada £5,000.			
Electric fittings, switches, fuses and lightning arresters.—			
From United Kingdom ...	51,000	15,000	– 36,000
,, Japan	—	12,000	+ 12,000
,, United States	16,000	22,000	+ 6,000
,, Other countries ...	14,000*	1,000	– 13,000
Total	81,000	50,000	– 31,000
* Germany £11,000.			
Telephones, telephone switchboards and appliances.—			
From United Kingdom ...	47,000	14,000	– 33,000
,, Belgium	25,000	—	– 25,000
,, Sweden	46,000	1,000	– 45,000
,, United States	47,000	42,000	– 5,000
Total	165,000	57,000	– 108,000
Wire (copper).—			
From United Kingdom ...	175,000	4,000	– 171,000
,, Japan	—	15,000	+ 15,000
,, United States	11,000	27,000	+ 16,000
,, Other countries ...	27,000*	7,000‡	– 20,000
Total	213,000	53,000	– 160,000
* Germany £19,000. ‡ Canada £7,000			
Cable and wire (covered).—			
From United Kingdom ...	554,000	24,000	– 530,000
,, Japan	—	124,000	+ 124,000
,, Italy	2,000	1,000	– 1,000
,, United States	20,000	32,000	+ 12,000
,, Other countries ...	61,000*	—	– 61,000
Total	637,000	181,000	– 456,000
* Germany £56,000.			
Arc lamp carbons.—			
From United Kingdom ...	—	3,000	+ 3,000
,, Spain	—	4,000	+ 4,000
,, United States	—	3,000	+ 3,000
,, Germany	17,000	—	– 17,000
,, Other countries ...	1,000	—	– 1,000
Total	18,000	10,000	– 8,000
Electrical appliances not included elsewhere.—			
From United Kingdom ...	90,000	47,000	– 43,000
,, Denmark	10,000	—	– 10,000
,, Japan	—	34,000	+ 34,000
,, Holland	10,000	68,000	+ 58,000
,, United States	36,000	82,000	+ 46,000
,, Other countries ...	65,000*	2,000	– 63,000
Total	211,000	233,000	+ 22,000
* Germany £55,000.			

	1913. £	1917-8. £	Inc. or Dec. £
Electric heating and cooking appliances.—			
From United Kingdom ...	7,000	6,000	– 1,000
,, United States	3,000	7,000	+ 4,000
Total	10,000	13,000	+ 3,000
Accumulators or storage batteries, arc lamps, vacuum tubes, instruments and insulating tape.—			
From United Kingdom ...	109,000	28,000	– 81,000
,, Sweden	1,000	1,000	—
,, United States	11,000	62,000	+ 51,000
,, Other countries ...	46,000*	6,000‡	– 40,000
Total	167,000	97,000	– 70,000
Coal-cutting machines.—			
From United States	19,000	10,000	– 9,000
Earth and rock cutting, excavating, &c., machines.—			
From United Kingdom ...	31,000	18,000	– 13,000
,, United States	18,000	14,000	– 4,000
,, Other countries ...	9,000	—	– 9,000
Total	58,000	32,000	– 26,000
Rotary and percussive rock drills.—			
From United Kingdom ...	3,000	5,000	+ 2,000
,, United States	28,000	27,000	– 1,000
,, Other countries ...	1,000	—	– 1,000
Total	32,000	32,000	—
Machine tools.—			
From United Kingdom ...	78,000	42,000	– 36,000
,, United States	55,000	56,000	+ 1,000
,, Other countries ...	15,000*	1,000	– 14,000
Total	148,000	99,000	– 49,000
Steam turbines, economisers, superheaters, &c.—			
From United Kingdom ...	92,000	69,000	– 23,000
,, United States	5,000	4,000	– 1,000
,, Other countries ...	11,000*	—	– 11,000
Total	108,000	73,000	– 35,000
High-speed reciprocating steam engines.—			
From United Kingdom ...	26,000	3,000	– 23,000
Motive power machinery, N.E.I.—			
From United Kingdom ...	263,000	33,000	– 230,000
,, Sweden	—	2,000	+ 2,000
,, United States	80,000	60,000	– 20,000
,, Other countries ...	34,000*	5,000‡	– 29,000
Total	377,000	100,000	– 277,000
Wire, iron, and steel.—			
From United Kingdom ...	89,000	5,000	– 84,000
,, Canada	2,000	40,000	+ 38,000
,, United States	219,000	420,000	+ 201,000
,, Other countries ...	330,000*	5,000‡	– 325,000
Total	640,000	470,000	– 170,000

* Germany £43,000. ‡ Switzerland £4,000.

* Germany, £11,000.

* Germany £11,000.

* Germany £20,000. ‡ Canada £5,000.

* Germany £327,000. ‡ Japan £3,000.

COMMERCIAL ENGINEERING.

AT the opening meeting of the LIVERPOOL SUB-CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS, on January 19th, Prof. E. W. MARCHANT, D.Sc., the chairman, delivered an address, of which the following is a brief résumé. The speaker's opening remarks were mainly directed to the position occupied by Liverpool in the shipping world, and also in the manufacture of cables and telegraph and telephone equipment. Prof. Marchant thought that the telegraph industry was very poorly represented, and the discussion of telegraphic problems occupied too small a proportion of the Institution's proceedings. He therefore expressed the hope that the new sub-centre would help to remedy this. Other subjects which the chairman commended to his audience were wireless telegraphy and electrical engineering in chemical works.

The future of the engineering graduate then received attention. It was often questioned whether the great number of men now undergoing training at universities, &c., could be absorbed at the end of their instruction. Having regard to the progress of electricity, and the certainty of huge future developments, the speaker thought that the need for such men would probably be greater than the supply. Prof. Marchant mentioned many industrial undertakings which offered a vast field for the electrical engineer, railways, mines, and all descriptions of factories. It had been said that university-trained engineers did not give the commercial side due consideration—aiming at efficiency rather than cheapness of production. He did not wholly agree, but allowed that the economic side of engineering should receive greater attention.

He said: "We have got to realise that under modern conditions, a vast number of trained engineers are wanted, who shall be equipped not only with technical knowledge, but with such knowledge also as will enable them to deal readily with commercial problems. If we are to satisfy this need, we shall look to close co-operation with those undertakings and industries which are associated with the works and factories in our district. The subject of cost of production is of fundamental importance.

I do not wish to suggest that all engineers in the future are not to be scientifically trained men, men whose business it is to harness the great sources of power in nature for the use and convenience of many kind, but I am inclined to think that the university graduate would be more efficient in carrying out his beneficent function, if he were a better business man. One of our members recently put forward a criticism of the university-trained graduate, which I have taken to heart, namely, that he was too apt to look at a project from the point of view of its theoretical or scientific efficiency, and not enough from the point of view of pounds, shillings, and pence; that he would decide in favour of a project because it gave an efficiency of 90 per cent., rather than in favour of another that gave an efficiency of 80 per cent., and cost half as much to develop. I do not think this criticism, as I have stated it, is a fair one, but I want to put the matter broadly, and there is I believe a great deal to be said for dealing more in detail with the economic side of engineering than has been customary in the past. One of the great deficiencies of the man in the street to-day is, I believe, his inability to understand economic problems. The last years of the war have taught us all a very great deal, and if the man of to-day has not realised the importance of increase of production for the well-being of the community it is not the fault of the newspapers. This, however, is only one side of the question. There is, I believe, a great and increasing field for scientifically trained engineers, in the business side of great undertakings. Mr. Swinburne once said "Any fool can invent a thing; it takes a clever man to make an invention a practical success; but it takes a genius to sell it."

Now I do not want to suggest that it is part of the function of the engineering faculty of a university or technical college to produce geniuses as Mr. Swinburne has defined them, but I am quite sure, as time goes on, that a larger number of trained engineers will be attracted to the commercial side of engineering works, and I think this tendency is wholly good.

It is good, I venture to think, from the point of view of industry; with the expanding activities of large electrical engineering firms, it is becoming more and more necessary that their representatives—especially those in foreign countries—should be well-trained engineers, able to discuss any problem that may arise in connection with the supply of electrical machinery and equipment with their clients. One of the most interesting developments of British industry has been the formation of the Federation of British Industries. This association has projected a great scheme of what they call trade ambassadors, who shall act in the 22 different sections into which they have divided the world, as connecting links between the manufacturer at home and the consumer in a foreign country. It is estimated that this plan will involve an expenditure of a million a year. In connection with such an organisation it seems evident that a number of highly trained technical engineers will be wanted, men who are able to familiarise themselves with local conditions, and shall have had a wide commercial experience. Such men, either in connection with such federation or in connection with private firms will, it is to be hoped, have had a university or technical college training. They will have to deal with technical engineering problems. It is as necessary that they shall be fully qualified engineers as the man who has to put the actual machinery in place, or to put it into operation. The universities in this country are now establishing schools of commerce, which are meeting with considerable support; it is to be hoped that technically trained engineers will also come into the organisation of such a system."

In his concluding remarks, Dr. Marchant spoke of the tremendous possibilities in wireless telegraphy and telephony following upon the invention of the three-electrode valve. He regarded this as of the first importance to Liverpool, as he considered the sub-centre the natural home of telegraphy.

Slough Motor Depôt.—Referring to the paragraph on page 84 of the ELECTRICAL REVIEW for January 16th, dealing with "The Slough Motor Depôt," the Western Electric Co., Ltd., inform us that they secured the order for the manufacture, laying, and jointing of *all* the main feeder and distribution cables. These are paper-insulated, lead-covered, and steel-tape armoured, laid direct in the ground.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

G.E. Co. Auto-Steriliser.

During the past few years the application of electricity to important work in connection with medicine, surgery, and dentistry has increased enormously on account of its cleanliness, adaptability, and safety.

One of the latest pieces of medical apparatus is an ingenious "auto-steriliser" patented by the GENERAL ELECTRIC CO., LTD., of 67, Queen Victoria Street, E.C.4. Made on the "Magnet" principle, *i.e.*, with easily replaceable heating element (immersion type), it embodies several valuable features, including a heat insulated handle for raising the lid, and a perforated self-draining instrument tray which is automatically lifted out of the liquid by lever hinges when the lid is raised (see fig. 1). In addition, there is a gutter or ledge which receives water condensing on the lid, and tips it back into the container when the lid is closed. The loading is such that the liquid is rapidly brought to boiling point, and the heating elements can be obtained for standard voltages of 100/110, 200/220, and 230/250.

FIG. 1.—"MAGNET" AUTO-STERILISER.

The method of use is to fill the containing vessel with water so that the heater is well covered and the instrument tray properly immersed, then to switch on the current, and as soon as the sterilisation is complete to raise the lid by means of the insulated handle. The instrument tray is thereby raised out of the water and the instruments dry rapidly by residual heat.

An Electrical Vaporiser.

We have described in our columns on previous occasions devices designed for the evaporation of paraffin and the heavier oils to permit their use for the propulsion of petrol engines, or to enable engines to be started up without difficulty in cold weather. The GENERAL ELECTRIC CO., LTD., of 67, Queen Victoria Street, E.C.4, has drawn our attention to another electrical vaporiser recently put on the market. This is known as the "Kramer-Vaporiser" (fig. 2), which consists of an asbestos cushion containing an electrical heating element. This cushion is mounted on the packing material between the induction and carburettor pipe flanges, and projects upwards into the entry pipe (figs. 3 and 4). On the suction stroke of the piston the cushion takes in the spray from the carburettor, and by means of its heating element converts the oil into the hot vapour necessary for starting the engine. The device can be made applicable to any make of engine, the heating element being wound to suit the accumulator or car-lighting voltages. The total weight is about 3 oz., and power consumption 30 watts. Flange packing is rendered unnecessary in most cases by the use of this vaporiser. The device is very easily fitted, it only being necessary to disconnect the flange of the induction and carburettor pipes, insert the cushion, and bolt up again. The terminals of the heating element are then connected by means of a flexible cord to a combined switch and pilot lamp and an accumulator, in parallel.

FIG. 2.—KRAMER-VAPORISER.

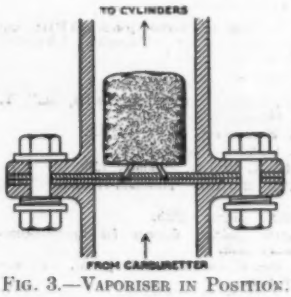

FIG. 3.—VAPORISER IN POSITION.

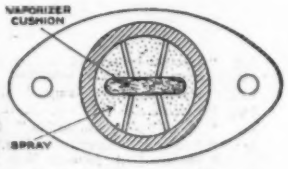

FIG. 4.—SECTIONAL PLAN OF INDUCTION AND CARBURETTOR PIPE, SHOWING POSITION OF VAPORISER.

Magnetic and Split-blade Screwdrivers.

In doing small repair work on electrical apparatus cases arise where the workman cannot hold a screw with his hand. Two screwdrivers, for large and small screws respectively, have been developed for use where this difficulty arises. The former (A) has a short shank and is magnetised, and the latter consists of a split-spring blade attached to a ¼-in. (6-mm.) rod. To use the screwdriver the two springs are sprung together and inserted in the screw slot. Their tendency to spring outward grips the screw.—*Electrical World*.

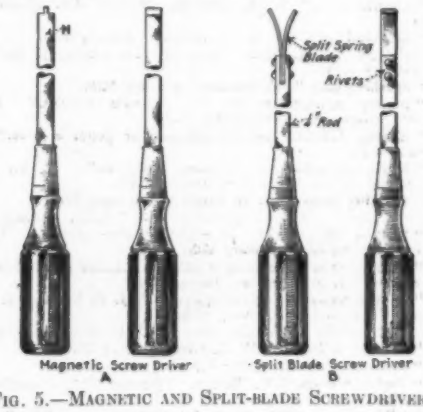

FIG. 5.—MAGNETIC AND SPLIT-BLADE SCREWDRIVERS.

Thermostatic Metal.

A special thermostatic metal has been developed for use on thermostatically operated devices of all kinds by the BRITISH THOMSON-HOUSTON CO., LTD., of 77, Upper Thames Street, London, E.C. 4.

The metal is in the form of a duplex strip, prepared by the permanent union, throughout their entire length, of two metals with widely differing co-efficients of expansion. When the strip is subjected to a change of temperature the difference in the rates of expansion or contraction of the two halves causes the whole strip to bend one way or another. This reaction is always the same for a given length and thickness of strip and a given temperature change, and consequently is claimed to provide a reliable basis for the operation of any thermostatic device.

The union between the component metals is complete and durable; no matter how much the strip is bent, twisted or hammered, the metals will not separate at any point, and even with heating the bond will not be broken down at a

temperature below the melting point of the softer of the two metals. Owing to this permanency of union the metal can be formed into any desired shape and annealed after formation. It can be safely employed at any temperature below 500 deg. F. The component metals will not corrode under ordinary conditions, and may be used in any reasonable situation without fear of deterioration or change in operating characteristics.

Thermostatic metal is made in standard thicknesses ranging from 0.015 to 0.25 in., in widths up to 6 in., and lengths to suit the purchaser, and in special cases thermostatic metal parts may be completely formed to specification.

NEW PATENTS APPLIED FOR 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

932. "Electric generators for electric-lighting sets of automobiles, &c." T. A. D. LAWTON and W. H. MARSTON. January 12th.

941. "Morse-signal'ing lamps." J. H. HANSEN. January 12th.

948. "Electric hea ·s." A. M. E. BEAVAN. January 12th.

968. "Electric plug connection." R. K. BUTLER. January 12th.

974. "Electron-discharge devices." BRITISH THOMSON-HOUSTON Co. (General Electric Co.) January 12th.

993. "Sparking plugs." T. C. SMITH. January 12th.

1,003. "Trip mechanism for electric ignition devices for internal-combustion engines." A. J. ADAMS. January 12th.

1,007. "Wireless direction-finding means for aircraft." J. M. FIRSIVAL and H. R. C. VAN DE VELDE. January 12th.

1,017. "Charging electrical accumulators." T. DICKINSON. January 12th.

1,025. "Galvanic batteries." G. OLDHAM, J. OLDHAM, O. OLDHAM, OLDHAM & SON. January 12th.

1,045. "Sparking plugs." H. S. COOKE. January 13th.

1,067. "Sparking plugs." W. C. BAYLISS and A. L. WOOD. January 13th.

1,079. "Electric lamps." W. W. SIMPSON. January 13th.

1,086. "Electrical connections." A. F. CAINE and EDISON SWAN ELECTRIC Co. January 13th.

1,089. "Electrical dry battery." W. KING. January 13th.

1,094. "Packing X-ray, &c., tubes and bulbs." A. ASTLEY. January 13th.

1,101. "Wireless direction-finding systems." F. MURPHY. January 13th.

1,122. "Mouthpieces of telephones, &c." J. E. HEARN and H. F. VARLEY. January 13th.

1,134. "Commutators for dynamo-electric machines." A. E. WHITE (Toledo Standard Commutator Co.) January 13th.

1,149. "Thermo-electric valve." A. E. KNIGHT. January 14th.

1,151. "Induction incandescent electric lamps." C. BEAVAN. January 17th.

1,152. "Electric welding." E. GREENHALGH and B. LONGBOTTOM. January 14th.

1,157. "Electric irons." B. H. FRANCOIS. January 14th. (France, March 12th, 1918.)

1,180. "Electrical switch." E. W. KITCHIN. January 14th.

1,187. "Holders for thermionic valves for radio-telegraphy, &c." E. W. KITCHIN. January 14th.

1,192. "Sparking plug." F. BURNETT. January 14th.

1,216. "Battery arrangement for small electric vehicles." R. SLABY. January 14th. (Germany, January 22nd, 1919.)

1,223. "Electric indicator for oil pressure or petrol engines." W. M. COX. January 14th.

1,249. "Radio-telegraphic and telephonic apparatus." H. ST. J. DE A. DONISTHORPE and R. M. RADIO, LTD. January 14th.

1,275. "Sparking plugs." E. R. EDWARDS. January 15th.

1,278. "Electric-lamp filament protector." C. SPENCER. January 15th.

1,296. "Ignition apparatus for internal-combustion engines." E. FLEMING and HOLLAND MOTORS, LTD. January 15th.

1,302. "Trolley wheel or contact control mechanism of overhead electric tramway system." J. J. JENNISON. January 15th.

1,314. "Electric motor-driving arrangements." J. F. CROWLEY and SIEMENS BROS. DYNAMO WORKS, LTD. January 15th.

1,318. "Electrical fire and burglar alarm." F. W. CONWAY. January 15th.

1,319. "Tumbler switches." H. CLEETON. January 15th.

1,336. "Electroscope." R. WHIDDINGTON. January 15th.

1,382. "Engine starters." V. BENDIX. January 15th. (United States, March 31st, 1919.)

1,383. "Utilisation of tidal energy for production of power." A. McKINSTRY and METROPOLITAN-VICKERS ELECTRICAL Co. January 15th.

1,384. "Armatures for dynamo-electric machines." METROPOLITAN-VICKERS ELECTRICAL Co. January 15th. (United States, January 16th, 1919.)

1,385. "Ignition apparatus for internal-combustion engines." BOSCH AKT. GES. R. (Germany, October 19th, 1918.) January 15th.

1,386. "Electrical condensers." BOSCH AKT. GES. R. January 15th. (Germany, March 15th, 1915.)

1,387. "Rotating interrupting devices for high-speed sparking apparatus." O. IMRAY (R. Bosch Akt. Ges.) January 15th.

1,388. "Ignition apparatus for internal-combustion engines." R. BOSCH AKT. GES. January 15th. (Germany, January 21st, 1918.)

1,390. "Portable electric generating sets." R. BOSCH AKT. GES. January 15th. (Germany, January 26th, 1918.)

1,391. "Device for preventing sparking in electric ignition circuit when lead becomes broken, for use in aeroplanes, &c." R. BOSCH AKT. GES. January 15th. (Germany, January 5th, 1918.)

1,396. "Medical electrodes." J. S. D. DUTHOIT. January 15th.

1,402. "Indicating arrangement for underground railways, tramways, &c." AUTOMATIC TELEPHONE MANUFACTURING Co. and S. R. SMITH. January 16th.

1,415. "Means for timing of electric ignition apparatus of internal-combustion engines." F. C. EWART. January 16th.

1,468. "Sparking plugs and methods of making same." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). January 16th.

1,474. "Magnetos." N. C. F. JENSEN and M. J. E. TILNEY. January 16th.

1,475. "Electrolysers." G. G. HEPBURN. January 16th.

1,489. "Starting device for internal-combustion motors." H. FUENTE. January 16th.

1,498. "Electric starting devices for internal-combustion engines." O. IMRAY (R. Bosch Akt. Ges.) January 16th.

1,499. "Magneto-generators." O. IMRAY (R. Bosch Akt. Ges.) January 16th.

1,500. "Devices for preventing starting of electrically-ignited internal-combustion engines." R. BOSCH AKT. GES. January 16th. (Germany, March 27th, 1916.)

1,504. "Magnetos." J. H. TOUNAYRE. January 16th. (France, February 21st, 1919.)

1,507. "Housings for mechanical interrupters of electric ignition apparatus." AMERICAN BOSCH MAGNETO CORPORATION. January 18th.

1,529. "Commutators." L. E. HODGES. January 17th.

1,541. "Electric heating element." H. J. DEAN-OSGOOD. January 17th.

1,551. "Induction incandescent electric lamps." C. BEAVAN, C. BEVAN and A. C. HOPPER. January 17th.

1,552. "Metal-filament vacuum and gas-filled incandescent electric lamps." C. BEAVAN, C. BEVAN and A. C. HOPPER. January 17th.

1,560. "Utilising power of sea for generating electricity." C. J. THOMPSON. January 17th.

1,566. "Fusible cut-outs and distribution fuse boards for electrical circuits." H. C. HODGES. January 17th.

1,575. "Starting systems for internal-combustion engines." DAYTON ENGINEERING LABORATORIES Co. January 17th. (United States, October 23rd, 1918.)

1,583. "Insulation of conductors of submarine cables." B. S. HUNT. January 17th.

1,587. "Electricity meters, &c." FERRANTI, LTD., S. Z. DE FERRANTI and G. WALL. January 17th.

1,591. "Electric condensers." BRITISH THOMSON-HOUSTON Co., H. L. DURRANT and A. P. YOUNG. January 17th.

1,610. "Electrical brush-gear." W. F. GRAFTON. January 17th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

1,634. DEVICE FOR REGULATING THE VOLTAGE OF CURRENT GENERATED BY A DYNAMO. Bosch Akt Ges. R. January 26th, 1917. (113,096.)

10,457. APPARATUS FOR ELECTRO-OSMOTICALLY REMOVING LIQUIDS FROM MATERIALS. Elektro-Osmose Akt. Ges. (Graf Schwerin Ges.) October 20th, 1917. (135,818.)

19,053. ELECTRIC HEATERS FOR LIQUIDS AND THE LIKE. P. J. H. Bernard. November 20th, 1918. (136,865.)

20,832. DYNAMO-ELECTRIC MACHINES. E. Harrison. December 13th, 1918. (136,872.)

21,547. ELECTRIC COOKING OR HEATING VESSELS AND APPARATUS. C. H. Lauth. December 23rd, 1918. (136,900.)

21,776. AUTOMATIC ELECTRIC WATER-HEATERS. G. P. Dennis and J. Law. December 30th, 1918. (136,913.)

21,913. ELECTRIC SWITCHES. E. Abegg. December 31st, 1918. (136,918.)

1919.

84. ELECTRIFICATION OF SEEDS AND APPARATUS THEREFOR. J. J. H. Sturmey and J. Hewett. January 2nd, 1919. (136,920.)

364. ELECTRIC FURNACES. Armour Fertiliser Works. January 28th, 1918. (122,828.)

4,320. ELECTRIC FURNACES. Watson & Co., H. A. Greaves, H. A. Etchells and W. Travis. February 21st, 1919. (136,961.)

5,216. CONNECTORS FOR USE WITH ELECTRICALLY-OPERATED OR HEATED DEVICES. G. H. Collins, H. F. Collins and C. G. Pitcher. March 3rd, 1919. (136,967.)

11,540. ELECTRICAL RESISTANCES. M. Perree. May 8th, 1919. (136,998.)

13,665. ELECTRICAL GENERATORS. B. Ames. May 29th, 1919. (137,002.)

13,667. ELECTRICAL CONDENSERS. B. Ames and P. J. Gilinson. May 29th, 1919. (137,003.)

14,919. AIR-COOLED SPARKING PLUGS. L. Pineschi. June 13th, 1919. (137,008.)

15,760. ELECTRIC COOKING OR HEATING APPARATUS. C. H. Lauth. December 23rd, 1918. (Divided application on 21,547/18.) (137,012.)

17,641. SELECTING DEVICES FOR AUTOMATIC TELEPHONE SYSTEMS. Siemens Bros. & Co. and D. A. Christian and G. P. Sumner. July 14th, 1919. (137,018.)

Petitions for Extensions of the Terms of Patents.—In connection with proceedings that are pending or contemplated under Section 18 of the Act of 1907, attention is directed to Section 6 of the Act of 1919. The general extension granted by the latter section renders premature the presentation or consideration at the present time of petitions in respect of patents the original term of which had not expired on December 23rd, 1919 (the date of the coming into force of the Act of 1919), as the Court would be unable at this date to determine satisfactorily the question whether or not the petitioner had been adequately remunerated.—*Illustrated Official Journal (Patents).*

Alpine Water Power.—A *Times* correspondent states that one of the most important schemes for the exploitation of the water power of Switzerland is that of the Forces Motrices Bernoises, which proposes to generate 210,000 H.P. in the Oberhasli Valley (Bernese Oberland). To this end a large dam has been erected at the foot of the Bächli Glacier, near the Juchlistock. The valley here is now a splendid lake surrounded by vast rocks, and washing up to the edge of the glacier. By the Grimsel the change is to be much greater still. From the formidable slopes of the Nägelis Grätli (above the Rhône Glacier) to the Unteraar Glacier there will be a lake just over three miles in length, taking in the two present lakes. The dam which will form this lake is to be over 320 ft. in height. The Gelmersee, too, is to have its dam, which will quadruple its area. There will be two power stations, one at Guttannen and one at Innertkirchen, but all tubes and pipes will be underground, so that the natural beauties of the district will not be disfigured. The total costs of the scheme are estimated at 100,000,000 fr. (about £4,000,000 sterling at the rate of 25 fr. to the sovereign), and it is hoped that the work will be completed within six years.